Appendix J.7

Fish Habitat Offset Plan: Preliminary Concept Update,

Wood Environment & Infrastructure Solutions

Fish Habitat Offset Plan: Preliminary Concept Update

Fifteen Mile Stream Project
Project # ONS2001

Prepared for:

Atlantic Mining Nova Scotia Inc.
595 Burrard Street, Suite 3083, Vancouver, BC, V7X 1L3

October 2020

Fish Habitat Offset Plan: Preliminary Concept Update

Fifteen Mile Stream Project

Atlantic Mining Nova Scotia Inc.

Project # ONS2001

Prepared for:

Atlantic Mining Nova Scotia Inc.
595 Burrard Street, Suite 3083, Vancouver, BC, V7X 1L3

Prepared by:

Wood Environment & Infrastructure Solutions
a Division of Wood Canada Limited
133 Crosbie Road
St. John's, NL A1B 4A5
Canada
T: 709-722-7023

October 2020

Copyright and non-disclosure notice

Third-party disclaimer

Executive Summary

Atlantic Mining Nova Scotia is Inc. proposing a gold mine and processing facility at Fifteen Mile Stream (FMS) called the Fifteen Mile Stream Gold Project (the Project). While mitigation measures are being developed to minimize Project effects, the location of the ore body and the required infrastructure is likely to cause the permanent loss of fish and fish habitat. Any Harmful Alteration, Disruption, or Destruction (HADD) of fish habitat will require authorization under Section 35 of the *Fisheries Act*. Additionally, any deposit of mineral waste (overburden, waste rock, effluent) in waters frequented by fish will require waterbodies to be listed in Schedule 2 of the Metal Diamond Mining Effluent Regulations (MDMER) in accordance with Section 36 of the *Fisheries Act*.

This document has been prepared to provide preliminary quantification of aquatic habitat potentially affected by the Project and to outline the conceptual offset measures proposed to compensate for any HADD determination. The intent is to further demonstrate that mitigation avoidance measures have been considered to minimize the overall HADD on fish and fish habitat and that the fish habitat offsetting concepts for the Project can meet the requirements of the *Fisheries Act*. The document provides Fisheries and Oceans Canada (DFO) with information to determine if measures to offset unavoidable HADD of fish habitat (as defined in the *Fisheries Act*) are reasonable and can be achieved. The impacts and offsetting concepts described will serve as the basis for ongoing consultation with Indigenous Groups and stakeholders and to ultimately support an application for authorization of HADD of fish habitat as required by the *Fisheries Act*.

As part of the early project planning and site assessment efforts, multiple site layouts were considered for both project efficiencies and the avoidance of impacts to fish frequented waters. Although components such as the open pit are fixed due to the orebody, other project footprints such as stockpiles, the TMF and road networks have some flexibility in their location. To this end, the Project team reviewed multiple locations and site plans for these features, before selecting the proposed arrangement. Extensive field investigations have not identified fish presence within the footprint of the Proposed TMF. However, correspondence with Environment and Climate Change Canada (ECCC) have indicated that a portion of WC-43 may be considered a waterbody frequented by fish, and as such would require listing in schedule 2 of the MDMER, unless additional fish sampling can clearly demonstrate that fish are not present at any time.

HADD Estimation

Using the identified fish species currently known to utilize this habitat, Habitat Suitability Index (HSI) values were generated for each species life stage using DFO data for water velocities, water depth, substrate, and where appropriate, emergent vegetation. Using these suitabilities, final Habitat Equivalent Units (HEUs) for the lost habitat were generated with the highest species life stage HEU value used to conservatively represent the overall HEU and therefore the HADD.

Efforts have been made to minimize residual effects of the Project on fish and fish habitat and to avoid HADD wherever possible. However, portions of Project infrastructure will result in the loss of existing fish habitat that is currently utilized by resident fish species. Table A provides a summary of the quantity of fish habitat to be lost by the project, its calculated Habitat Equivalent Units, mitigation habitat used to reduce overall habitat losses (and its Habitat Equivalent Units), and the overall residual habitat losses. It is understood that the final HADD determination will be provided by DFO; however, this preliminary

quantification is provided to show that the offset concepts described can be designed to meet HADD quantity expectations, including any offset ratios.

Offset Concepts

Offsetting alternatives provided have been developed consistent with DFO's guidance Policy for Applying Measures to Offset Adverse Effects on Fish and Fish Habitat Under the *Fisheries Act*; however, preferred offsetting options will be further refined based on discussions with DFO and relevant stakeholders during the detailed offset planning process. It is also possible that alternative approaches not listed could be integrated into any Final Authorization Application (via an offsetting Plan) if required. Conceptual offset planning should enable DFO and others to assess the alternatives for feasibility and acceptability. Several concepts that have been considered feasible at the concept stage and, based on habitat needs of resident species and experience on similar offset designs, have a high degree of successful implementation.

The biological habitat design of the **Seloam Brook Realignment Channel** will provide suitable habitat features for spawning, rearing and migration. The channel realignment design will include an integrated floodplain and natural channel design principles to develop highly suitable fish habitat with biological features to mitigate a large portion of the habitat losses within Seloam Brook and avoid additional HADD. Habitat design will incorporate features to mimic characteristics within the existing habitat that will be lost but will also include increased species-specific spawning habitat to provide greater productivity potential. The channel will have a better-defined flow path to improve fish passage through the reach and mitigate the braided configuration of the existing habitat, caused by past mining activities, and will utilize the consolidated flow to maximize habitat stability and suitability.

In addition to the Seloam Brook realignment design, additional **off-channel habitat** would be constructed within the Seloam / Trafalgar Brook ecological unit. While the exact locations require further investigation of geotechnical, hydrogeological, and terrain constraints, the proposed concept is to install rock weir riffle enhancements immediately downstream of all mitigation structures and excavate ponds as off-channel habitat adjacent to the existing channel. The proposed objective is the creation of at least 6,300 Habitat Equivalent Units of high-quality pond and stream habitat to offset a portion of the remaining habitat units lost related to existing stream and open water habitat within the Project infrastructure footprint and TMF. The exact locations of the measure will need further adjustment to reflect ongoing flow modeling efforts, but sufficient areas exist adjacent to the Project to provide a high degree of certainty for this alternative.

The same concept and general methodology described for onsite could be applied to other locations offsite (i.e., outside the Selaom / Trafalgar Brook ecological unit), should it be required or should it be deemed more beneficial to fish populations in other locations than those near the Project area. This offsite alternative, however, was ranked lower due to greater risks and challenges related to land tenure and not being a direct benefit within the watershed(s) being affected by the Project.

Measures to **improve existing fisheries knowledge** in areas of interest to Indigenous communities could provide information related to possible future habitat rehabilitation options, additional habitat utilization, and/or species distributions / movement patterns in Nova Scotia, particularly in areas near the Project. The exact format of complementary measures will depend on consultations between Atlantic Mining Nova Scotia Inc. representatives and local Indigenous communities. While complementary measures are typically limited to a maximum of 10% of the offset plan, this option can provide additional avenues for alternative offset options. This alternative was ranked as third highest due to its flexibility and ability to align with specific interests of stakeholders.

Additional options investigated included the **rehabilitation / restoration of degraded aquatic habitats** both within and beyond former mining areas including old stream realignments, dewatered / infilled stream reaches, and man-made barriers. Restoration methods are well-known and can be very successful if used in the proper location. Discussions with groups involved in the planning of remediation of former mining areas indicate that additional coordination may be challenging due to land tenure challenges and liabilities; however, alternate locations may be identified through consultations with local stakeholders and Indigenous communities. These would be considered if required; however, are a lower overall ranking due to numerous uncertainties with their implementation.

Engagement

Engagement is a key component of Atlantic Mining Nova Scotia Inc.'s approach to the planning and implementation of its projects and other business activities. Several engagement initiatives have been undertaken in relation to the Project, with further engagement in progress or being planned. This includes discussions with relevant government departments and agencies, Indigenous communities and stakeholder organizations.

The Environmental Impact Statement documents describe previous and ongoing engagement initiatives related to the Project with Indigenous groups and the public. To continue in the vein of open communications on the Project, Atlantic Mining Nova Scotia Inc. is committed to meeting with and/or providing information to stakeholders at the appropriate time to discuss any offsetting plans.

Summary

Efforts have been made to minimize residual effects of the Project on fish and fish habitat and to avoid HADD wherever possible, however; portions of Project infrastructure will result in the loss of existing fish habitat that is currently utilized by resident fish species. It is understood that the final HADD determination will be provided by DFO; however, this preliminary quantification is provided to show that the offset concepts described can be designed to meet HADD quantity expectations, including any offset ratios.

Table A: Summary of Habitat Lost and Mitigations for FMS Project Infrastructure Footprint and TMF

Habitat measure	Project Area	Habitat Type	Total Habitat Area (m^2)	HEU (m^2)	Description
Lost	Infrastructure Footprint	Stream	8,334	3,333	Highest Habitat Equivalent Unit for adult Brook Trout.
		Open Water	19,113	4,730	Highest Habitat Equivalent Unit for both spawning and adult Brook Trout.
		Wetland	51,179	0	No Habitat Equivalent Unit value.
	TMF	Stream	1,947	953	Highest Habitat Equivalent Unit for adult White Sucker.
		Open Water	0	-	No open water habitat present
		Wetland	0	-	No wetland habitat present
Total			**80,573**	**9,016**	
Mitigation	Realignment	Stream	4,640	4,640	Will be designed as suitable for all species present within the footprint.
	Flood Area	Open Water	84,449	20,901	Will be designed as suitable as possible for all species present with adult Brook Trout as the habitat template.
		Wetland	0	-	No emergent vegetation habitat will be designed or constructed.
Total			**89,089**	**25,541**	
Residual HADD				**-16,525**	Net increase in Habitat Equivalent Units with the development of appropriate mitigations

Table of Contents

Page

List of Appendices

List of Tables

Page

List of Tables

List of Acronyms

ATV – All Terrain Vehicle
UTV – Utility Terrain Vehicle
cfs – Cubic Feet per Second
m^3/s – Cubic Metres per Second
m – Metre
m/s – Metres per Second
FMS - Fifteen Mile Stream
HADD - Harmful Alteration, Disruption, or Destruction
MDMER - Metal Diamond Mining Effluent Regulations

1.0 Introduction

Atlantic Mining Nova Scotia Inc. is proposing a gold mine and processing facility at Fifteen Mile Stream (FMS) called the Fifteen Mile Stream Gold Project (the Project). It is located in the East River Sheet Harbour watershed approximately 100 km northeast of Halifax, Nova Scotia (Figure 1). While mitigation measures are being developed to minimize Project effects, the location of the ore bodies and the required infrastructure is likely to cause the permanent loss of fish and fish habitat. Any Harmful Alteration, Disruption, or Destruction (HADD) of fish habitat will require authorization under Section 35 of the *Fisheries Act*. Additionally, any deposit of mineral waste (overburden, waste rock, effluent) in waters frequented by fish will require waterbodies to be listed in Schedule 2 of the Metal Diamond Mining Effluent Regulations (MDMER) in accordance with Section 36 of the *Fisheries Act*.

This document has been prepared to provide preliminary quantification of aquatic habitat potentially affected by the Project and to outline the conceptual offset measures proposed to compensate for any HADD determination. This Plan is supported by and builds upon the previous studies and documentation completed by McCallum Environmental Ltd, Knight-Piesold Consulting, and others. Detailed baseline aquatic habitat data has been collected by McCallum Environmental Ltd. personnel and where ongoing model and design work is applicable, it has been included or referenced.

The intent of this document is to further demonstrate that mitigation avoidance measures have been considered to minimize the overall HADD on fish and fish habitat and that the fish habitat offsetting concepts for the Project can meet the requirements of the *Fisheries Act*. The document will provide Fisheries and Oceans Canada (DFO) with the information necessary to determine if measures to offset unavoidable HADD of fish habitat (as defined in the Fisheries Act) are reasonable and can be achieved. The Conceptual Offsetting Plan has the following objectives:

1. Describe the fish species, habitat and population productivity being affected by the proposed Project;
2. Identify the likely residual effects of the Project that will result in HADD of fish habitat; and
3. Describe the proposed concepts to offset the loss of fish productive capacity.

The organization of this report is based on DFO guidance concerning the Fisheries Protection Policy, fish habitat offsetting, and the content of applications for *Fisheries Act* Authorization (DFO, 2013, 2019a, 2019b). The impacts and offsetting concepts described will serve as the basis for ongoing consultation with Indigenous Groups and stakeholders and to ultimately support an application for authorization of HADD of fish habitat as required by the *Fisheries Act*.

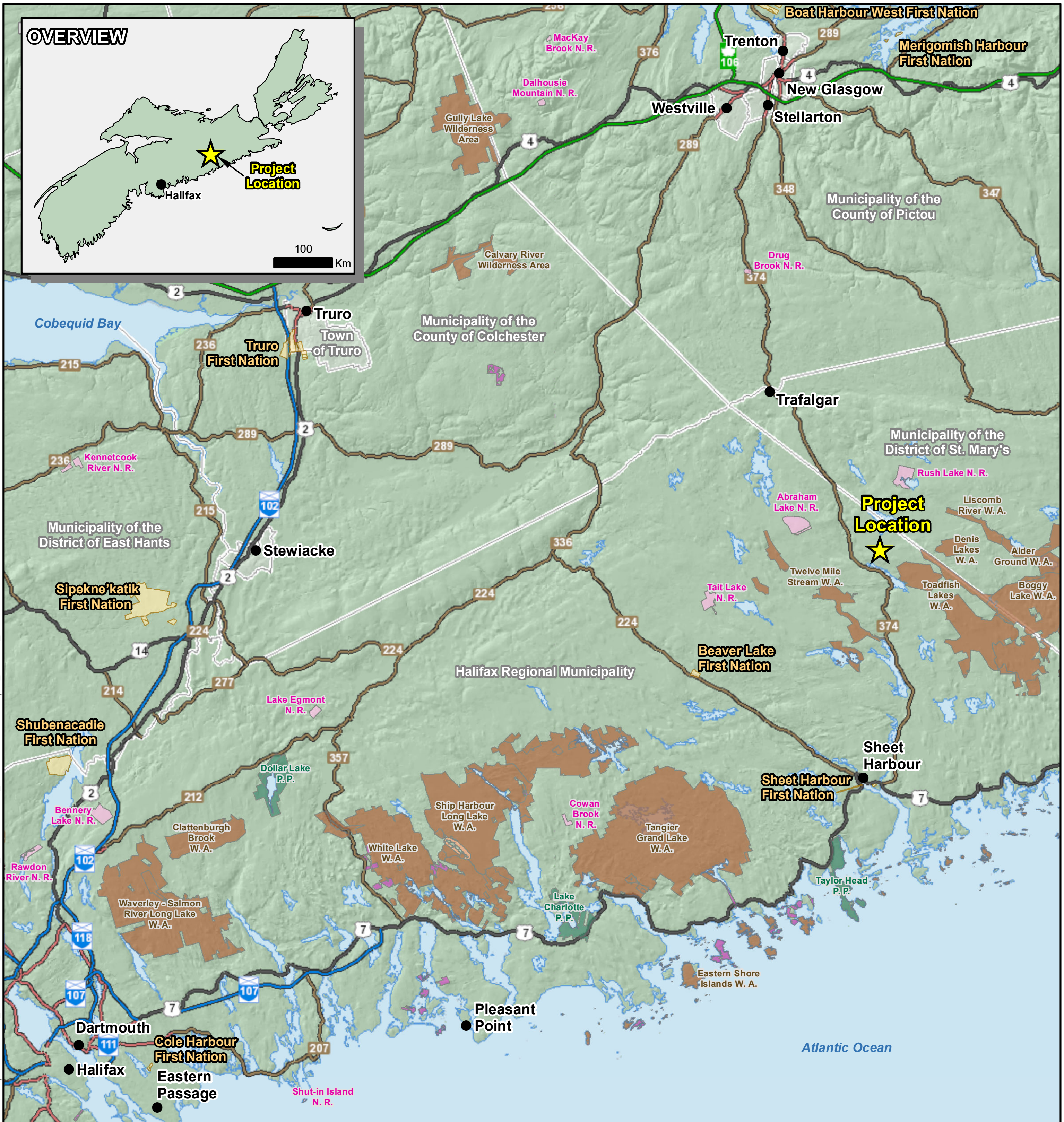
1.1 Project Contact Information

Proponent:

Names and address of Owner
Atlantic Mining Nova Scotia Inc.
409 Billybell Way, Mooseland
Middle Musquodoboit
Nova Scotia, Canada B0N 1X0
Tel +902.384.2772, Fax +902.384.2259

Authorized Contact Person
Attention to:
James Millard
Manager Environment and Community
Tel: 902.499.7910
Email: jmillard@atlanticgoldcorporation.com

Mr. Millard is an authorized representative for the Proponent and will be the signing authority for the Application(s), on behalf of the Proponent.



P:\2020\Projects\ONS2001_Atlantic Gold_Fifteen Mile Stream\11_GIS\Alternatives_Assessment\MXD\Project_Location_3.mxd

LEGEND

- Project Location
- Name ● City / Town
- Name Municipal Boundary
- Name First Nation Reserves

Protected Areas

- Conservation Easement
- Land Trust Property
- N. R. Nature Reserve
- P. P. Provincial Park
- W. A. Wilderness Area

NOTES:
- Topogarphic base data extracted from Nova Scotia GeoPortal and Web Mapping Service.

Atlantic Gold
A St Barbara Ltd Company

wood.

FIFTEEN MILE STREAM GOLD PROJECT

Project Location

Datum: NAD83
Projection: UTM Zone 20N

0 5 10 20 30 40 50 Kilometres

PROJECT N^{o}: ONS2001

FIGURE: 1

SCALE: 1:550,000

DATE: July 2020

2.0 Regulatory Context

DFO's Policy for Applying Measures to Offset Adverse Effects on Fish and Fish Habitat Under the *Fisheries Act* (DFO 2019) states the following:

> *Works, undertakings or activities resulting in the death of fish or the harmful alteration, disruption or destruction of fish habitat are prohibited under the Fisheries Act unless otherwise authorized. Before approving works, undertakings or activities that will result in the death of fish and/or the harmful alteration, disruption or destruction of fish habitat, Fisheries and Oceans Canada (the Department), must consider if there are alternatives that avoid adverse effects on fish and fish habitat. If the adverse effects on fish and fish habitat are unavoidable, the Department must consider if there are measures to mitigate that would reduce or minimize those adverse effects. Finally, if there are any residual effects, then the Department must consider measures to offset or counterbalance the death of fish and the harmful alteration, disruption or destruction of fish habitat.*

The project is currently undergoing provincial and federal environmental assessment under the Nova Scotia Environment Act and Canadian Environmental Assessment Act, 2012 respectively. The assessment document describes the residual effects on fish and fish habitat when full project mitigations have been considered. As part of the planning and permitting process, the environmental assessment documents and this conceptual offset plan will be reviewed by DFO to confirm the likely residual effects of the Project on fish and fish habitat and the need for a Federal Fisheries Authorization. Subsequently, a *Fisheries Act* Application for Authorization including a detailed offsetting plan will be developed.

In addition to likely residual impacts that constitute a HADD; any fish and fish habitat that may be subject to a Metals and Diamond Mine effluent Regulation Schedule 2 designation and accordingly a fish habitat compensation process has also been included within this document.

2.1 Document Overview

This document is organized into the following sections:

- Brief Description of the Proposed Undertaking and Activities (Section 3);
- Existing Aquatic Habitat (Section 4);
- HADD and Schedule 2 Habitat Quantification (Section 5); and
- Habitat Offset Concepts (Section 6)

3.0 Proposed Work, Undertaking and Activities

The Project is proposed to be developed in association with the currently operating Touquoy Mine. The Project is to be permitted and operated as a separate satellite surface mine operating at a rate of approximately two million tonnes (Mt) of gold-bearing ore per year. FMS ore will be crushed and concentrated through on site processing to produce a gold concentrate which will be hauled by on-road highway trucks to the Touquoy Mine Site carbon-in-leach (CIL) processing facility, a distance of just over 76 km on existing public roads, for final processing into gold ore bars. This will eliminate the need for a separate CIL cyanide leach circuit at the FMS Mine Site to support the Project. The FMS concentrate will be processed at the Touquoy Mine Site in conjunction with ore supply from Touquoy, Beaver Dam and Cochrane Hill surface mines.

The mine will operate for 7 years and will employ up to 200 persons including both salaried and hourly personnel. At the cessation of mining activities, the site will be reclaimed in accordance with federal and provincial requirements.

Operations at the Project location will include mining, crushing, ore processing and concentration, and operation of a waste rock storage facility (WRSF), ore stockpiles, and a tailings management facility (TMF). Tailings will be generated from the on-site mill processing and deposited into an above ground TMF. Infrastructure will include crushing facilities, fine ore stockpile and reclaim, concentrator facilities, maintenance facilities, fuel storage, office infrastructure, and site haul roads.

Power will be supplied via a small 5.3 km long spur transmission line and sub-station from an existing 69 kV, north-south hydroelectric transmission line located west of Highway 374. The sub-station will step the voltage down to 25 kV.

Development of the Open Pit will require the realignment of Seloam Brook. An 800 m realignment channel will be constructed to divert Seloam Brook to the north of the pit.

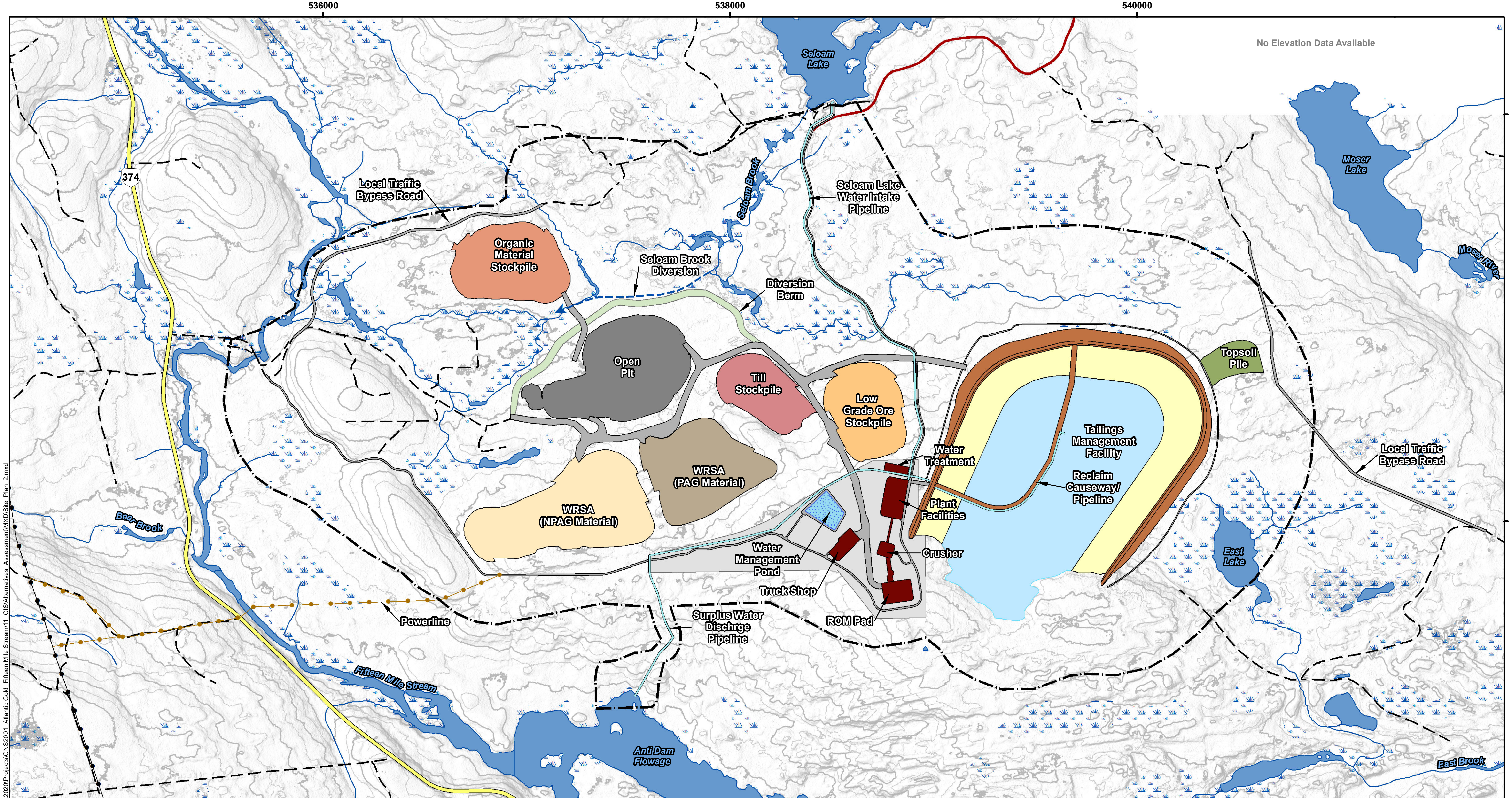
The total infrastructure footprint of the Project is approximately 375 ha and will consist of the following primary components:

- Open pit for extracting ore and waste rock;
- Mine site haul roads;
- Local traffic bypass roads;
- Powerline;
- Waste rock storage area (WRSA);
- Overburden till piles;
- Topsoil and organics storage piles;
- Separate run of mine (ROM) stockpile and low-grade ore (LGO) stockpile;
- Seloam Brook realignment and realignment berms around open pit;

- Crusher and concentrator facilities;
- Tailings management facility (TMF); and
- Water management system including water discharge.

The Project layout is shown on Figure 2. In addition to the components listed above, the Project will include all temporary activities associated with construction including temporary stockpiles, laydown areas, access roads, water management, temporary flow isolation, environmental control measures (e.g., silt fencing), temporary facilities, and creek crossings, where required.

Detailed descriptions of the Project components and their interactions with the environment can be found in the Fifteen Mile Stream Project Environmental Impact Statement / Environmental Assessment (EA) documentation.



LEGEND

- Property Boundary
- Utility Line
- Highway
- Local
- Resource / Track
- Watercourse
- Waterbody
- Wetland
- Major Contours (10 metre intervals)
- Minor Contours (5 metre intervals)

Proposed Mine Features

- Seloam Brook Diversion
- Powerline
- Pipeline
- Open Pit
- Tailings Management Facility Dam
- Deposited Tailings
- Tailings Management Facility Pond
- Low Grade Ore Stockpile
- Organic Material Stockpile
- Topsoil Pile
- Till Stockpile
- WRSA (NAG Stockpile)
- WRSA (PAG Stockpile)
- Diversion Berm
- Water Management Pond
- Buildings / Crusher
- Administration Area
- Haul / Access Roads

NOTES:
- Proposed site plan layout provided by Knight Piésold Consulting, June 18, 2020.
- Topogarphic base data extracted from Nova Scotia GeoPortal.

Datum: NAD83
Projection: UTM Zone 20N

0 0.5 1 2 3 4 5 Kilometres

Atlantic Gold A St Barbara Ltd Company | wood.

FIFTEEN MILE STREAM GOLD PROJECT

Project Site Plan

PROJECT N°: ONS2001	FIGURE: 2
SCALE: 1:18,000	DATE: July 2020

4.0 Existing Fish and Fish Habitat

The first step of the HADD determination process is to identify whether fish habitat is present within an area to be potentially impacted by a project. If fish habitat is present, fish species utilizing that habitat, including their different life stages, are identified and the habitat to be potentially impacted is classified and quantified. Fish habitat is defined in the *Fisheries Act* as '*spawning grounds and nursery, rearing, food supply and migration areas on which fish depend, directly or indirectly, in order to carry out their life processes*'. Thus, fish habitat is comprised of the physical, chemical and biological attributes of the environment. Therefore, a standardized classification system that provides accurate information on fish habitat is essential when conducting habitat assessments (DFO 2012).

The existing fish habitat within the Project Study Area have been described and quantified using fish and fish habitat data collected using a variety of methods. Sampling was completed by McCallum Environmental Ltd. throughout 2017-2020. This data has been used to determine fish habitat and species presence and to complete a quantification process for HADD determination using methods to calculate species habitat suitability and habitat utilization indices. All watershed drainages defined as potential fish bearing waters, and therefore fish habitat, as per federal (see above) or provincial definitions were surveyed in terms of physical and chemical characteristics. To determine fish species presences and suitability of the watershed drainages as fish habitat, surveys were completed using electrofishing (index and quantitative), fyke nets, eel pots, minnow traps, and environmental DNA. The results provide the data required to delineate fish species presence, distribution, estimates of fish abundance within the FMS Project footprint.

4.1 Fish Species and Abundance

A series of surveys including electrofishing, fyke netting, eel pots, and minnow traps were deployed within the Project Study Area to determine the fish species present. Species abundance estimates were developing using electrofishing Catch-per-Unit Effort (CPUE) indices, standardized to 300 seconds of effort (Scruton and Gibson 1995).

The species identified within the Project Area have been used in the Habitat Suitability and Habitat Utilization Index calculations as part of the HADD and Offset determination processes.

Within the Project Study Area, a total of 8 fish species have been captured which include Brook Trout (*Salvelinus fontinalis*), White Sucker (*Catostomus commersoni*), Lake Chub (*Couesius plumbeus*), Ninespine Stickleback (*Pungitius pungitius*), Golden shiner (*Notemigonus crysoleucas*), Brown Bullhead (*Ameiurus nebulosus*), Banded Killifish (*Fundulus diaphanous*) and Pearl Dace (*Margariscus margarita*). Within the Project Footprint where waterbodies will be impacted, four species have been captured; Brook Trout, Lake Chub, Pearl Dace, and White Sucker (Table 1). While abundance was generally low, any habitat affected within the Project Area will be quantified using all four species confirmed present.

The efforts to further delineate species distribution using other methods are ongoing and results can be updated as they become available. This will be important in the delineation of Schedule 2 requirements.

4.2 Habitat Characterization

The characterization of fish habitat for the purposes of determining HADD to fish habitat and MDMER Schedule 2 waterbodies requires a quantitative process that removes as much subjectivity as possible so that final determinations are defensible in approach and rationale. A revised federal habitat classification and quantification system was developed by DFO Newfoundland and Labrador Region to assist in assessing proposed developments for potential to cause HADD of fish habitat. An overview of the process is provided below based on information contained within McCarthy et al. (2007) and DFO (2012). While developed in a different region of Atlantic Canada, it is adjacent and appropriate for the similar dominant maritime fish complex found within the Project footprint.

There have been many habitat descriptions and habitat survey methodologies developed and used both within Atlantic Canada (e.g., Beak 1980; Scruton et al. 1992; Scruton and Gibson 1993; 1995; Sooley et al. 1998; DFO 2000), elsewhere in North America (e.g., Bisson et al. 1982; Oswood and Barber 1982; Barber et al. 1981; Platts et al. 1983; McCain et al. 1990; Osborne et al. 1991; Nickelson et al. 1992; Newbury and Gaboury 1993; Flosi and Reynolds 1994; Hawkins et al. 1993; Armatrout 1996; McMahon et al. 1996; Bain and Stevenson 1999) and Norway (Borsanyi 1982; Borsanyi et al. 2002).

The former Beak (1980) method, which has previously been utilized to characterize habitat is limited by its focus on salmonid species, mainly Atlantic Salmon (*Salmo salar*) and to a lesser degree Brook Trout (*Salvelinus fontinalis*), as evident in the descriptions. The revised classification system used within this document attempts to broaden the classification of habitat types (Table 2) to encompass all freshwater species, thereby contributing to a more consistent approach to HADD quantification (DFO 2012).

Each habitat type contains discrete as possible gradient, substrate types, water depth, and velocity ranges which have been determined using the described biological ‘preferences’ outlined in Grant and Lee (2004). It should be noted that not all habitat parameter descriptions are exclusive of all others (e.g., water depth); however, the combined parameters and the tiered approach to characterization based on gradient initially, then substrate, then water depth / velocity offer a reasonable designation of most habitat types encountered.

Each stream reach potentially affected by the Project has been identified using the existing project infrastructure layout and the existing aquatic habitat mapping (Figure 3). As shown in subsequent sections, mitigations to avoid negative effects to habitat beyond the project footprint have been incorporated to minimize HADD resulting from the Project. Mitigations include best available infrastructure placement to avoid unnecessary loss of fish habitat and stream realignments to maintain habitat suitability, connectivity and downstream flows.

Each habitat type has been characterized via surveys using standard methodologies to gather important diagnostic measurements such as reach length (m), reach wetted and bankfull width (m), reach slope (%), stream substrate composition (% composition), water depths (m), water velocities (m/s), and riparian habitat (% cover). The data was used to determine the overall habitat area within each reach as well as the habitat suitability, based on measured stream substrate, water depths, and water velocities (habitat parameters) for each fish species identified within the Project footprint.

Habitat suitability values were calculated for applicable life stages for each species; spawning, young-of-year, juvenile, and adult. The final calculation of a Habitat Utilization Index (HUI) for each species life stage is completed by multiplying the final habitat suitability value and the habitat area for each reach. Total HUI values for all reaches are combined for an overall Species life stage HUI value. To be conservative and to ensure that all species and life stages possibly utilizing the habitat are accounted for, the highest Species life stage HUI calculated represents the largest habitat loss and is therefore used to quantify the

HADD for the purpose of offset planning and authorization. This procedure has been completed for Section 35 HADD determination and Schedule 2 separately.

Using avoidance and mitigations, only those habitats within the footprint as well as those directly downstream that would no longer receive adequate flows are shown as these are considered HADD (Table 3). Quantification of the habitat in terms of species life stage HUI values are provided below.

Table 1: Summary of Electrofishing Catch-per-Unit Effort (CPUE) within the Project Footprint

Species	Total Catch (fish)	Total Effort (seconds)	CPUE (fish/300 seconds)
Brook Trout	8	1673	1.43
Lake Chub	8		1.43
Pearl Dace	1		0.18
White Sucker	3		0.54
Total	20	1673	3.59

Table 2: Descriptions of Riverine Habitat Classifications (as per DFO 2012).

Habitat Type	Habitat Parameter	Description
Fast Water	**Mean Water Velocity**	**> 0.5 m/s.**
	Stream Gradient	**Generally, > 4%.**
Rapid	General Description	Considerable white water[1] present.
	Mean Water Velocity	> 0.5 m/s.
	Mean Water Depth	< 0.6 m.
	Substrate	Usually dominated by boulder (Coarse[2]) and rubble (Medium[2]) with finer substrates (Medium and Fine[2]) possibly present in smaller amounts. Larger boulders typically break the surface.
	Stream Gradient	Generally, 4-7%.
Falls / Chute / Cascade	General Description	Mainly white-water present. The dominating feature is a rapid change in stream gradient with most water free-falling over a vertical drop or series of drops.
	Mean Water Velocity	> 0.5 m/s.
	Mean Water Depth	Variable and will depend on degree of constriction of stream banks.
	Substrate	Dominated by bedrock and/or large boulders (Coarse).
	Stream Gradient	> 7% and can be as high as 100%.
Run	General Description	Relatively swift flowing, laminar[3] and non-turbulent.
	Mean Water Velocity	> 0.5 m/s.
	Mean Water Depth	> 0.3 m.
	Substrate	Predominantly gravel, cobble and rubble (Medium) with some boulder (Coarse) and sand (Fine) in smaller amounts.
	Stream Gradient	Typically, < 4% (exception to gradient rule of thumb).
Moderate Water	**Mean Water Velocity**	**0.2-0.5 m/s.**
	Stream Gradient	**>1 and < 4%.**
Riffle	General Description	Relatively shallow and characterized by a turbulent surface[4] with little or no white water.
	Mean Water Velocity	0.2 – 0.5 m/s.
	Mean Water Depth	< 0.3 m.
	Substrate	Typically dominated by gravel and cobble (Medium) with some finer substrates present, such as sand (Fine). A small number of larger substrates (Coarse) may be present, which may break the surface.[5]
	Stream Gradient	Generally, >1 and < 4%.
Steady / Flat	General Description	Relatively slow-flowing, width is usually wider than stream average and generally has a flat bottom.
	Mean Water Velocity	0.2 - 0.5 m/s.
	Mean Water Depth	>0.2 m.
	Substrate	Predominantly sand and finer substrates (Fine) with some gravel and cobble (Medium).
	Stream Gradient	> 1 and < 4%.
Slow Water	**Mean Water Velocity**	**Generally, < 0.2 m/s (some eddies can be up to 0.4 m/s).**
	Stream Gradient	**< 1%.**
Plunge / Trench / Debris Pools	General Description	Generally caused by increased erosion near or around a larger, embedded object in the stream such as a rock or log or created by upstream water impoundment resulting from a complete, or near complete, channel blockage. These pool types may be classified as an entire reach (e.g., pools greater than 60% of the stream width) or as sub-divisions of a fast water habitat.
	Mean Water Velocity	< 0.2 m/s.

Habitat Type	Habitat Parameter	Description
	Mean Water Depth	> 0.5 m depending on stream size (e.g., may be shallower in smaller systems).
	Substrate	Highly variable (i.e., coarse, medium or fine substrates).
	Stream Gradient	Generally, < 1%.
Eddy	General Description	Relatively small pools caused by a combination of damming and scour: however, scour is the dominant forming action. Formation is due to a partial obstruction to stream flow from boulders, roots and/or logs. Partial blockage of flow creates erosion near obstruction. It is typically < 60% of the stream width and hence will be a sub-division of a faster-water habitat type (e.g., Run with 20% eddies).
	Mean Water Velocity	Typically, < 0.4 m/s, but can be variable.
	Mean Water Depth	> 0.3 m. May vary depending on obstruction type, orientation, streambed and bank material and flows experienced.
	Substrate	Predominantly sand, silt and organics (Fine) with some gravels (Medium) in smaller amounts.
	Stream Gradient	Variable.

Notes:

1 White water is present when hydraulic jumps are sufficient to entrain air bubbles which disturb the water surface and reduces visibility of objects in the water.

2 Coarse, Medium and Fine substrate types are classified according to the Standard Methods Guide for the Classification / Quantification of Lacustrine Habitat in Newfoundland and Labrador (Bradbury et al. 2001).

3 Laminar describes the surface of the water as smooth and glass-like with no reduced visibility of objects in the water.

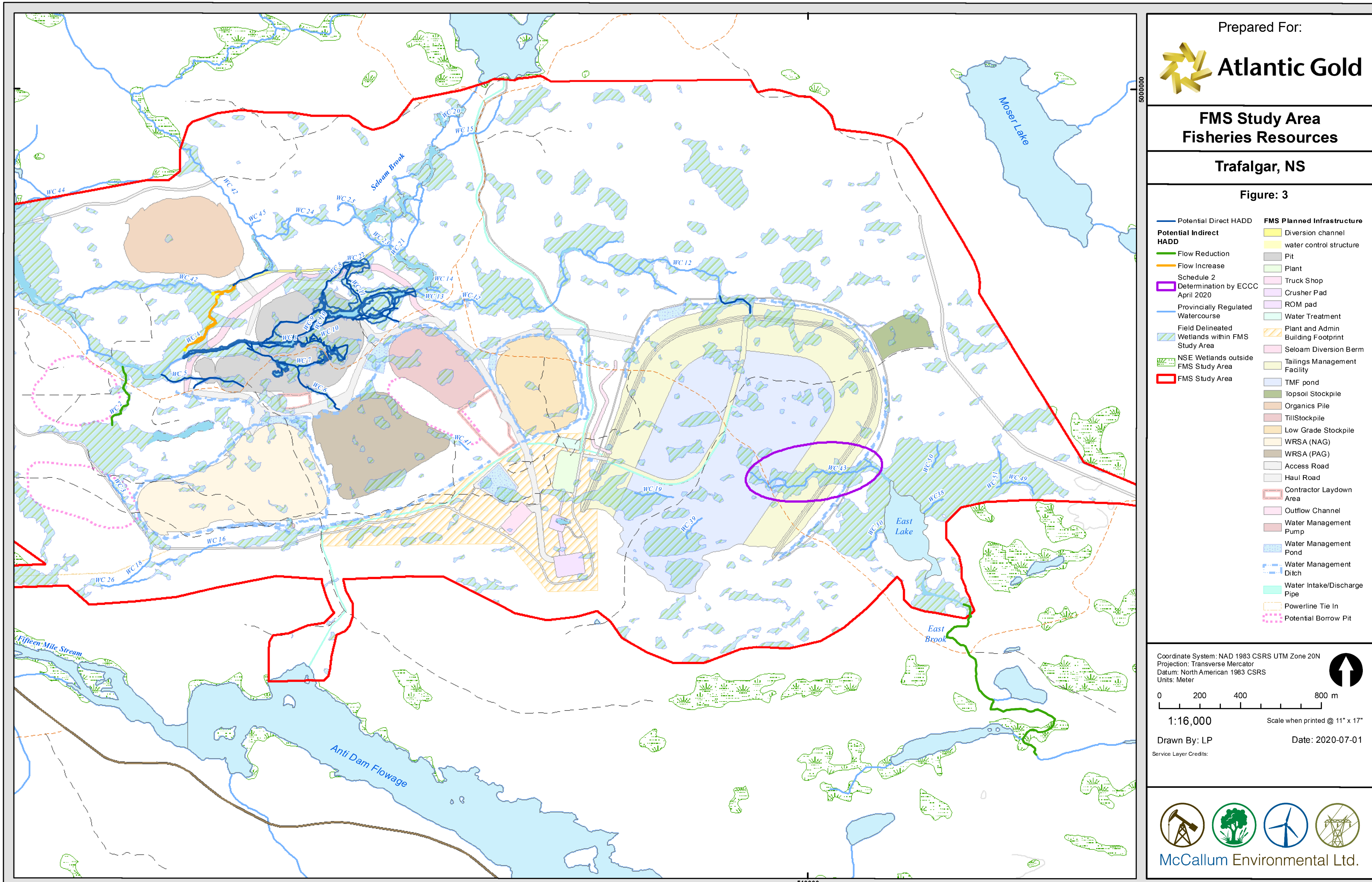
4 Turbulence is present if there are local patches of white water or if water movement disturbs a portion of the surface.

5 Pocket water often constitutes an important component of riffles in Newfoundland and Labrador and is characterized by a predominance of larger substrates (e.g., boulders) breaking the surface. The result is a riffle with many eddies around the boulders.

Table 3: Summary of Project Area Watercourses and Key Diagnostic Features within the Project Infrastructure Footprint and the TMF

Watercourse	Project Area	Area (m^2)	Habitat	Slope (%)	Mean Depth (m)	Dominant Substrate	Emergent Vegetation Coverage
1 (Seloam Brook)	Infrastructure Footprint	3,804	Steady	1.30	0.58	Boulder	0
5*		397	Riffle	1.98	0.15	Detritus	0
6*		135	Steady	1.31	0.30	Fines	0
7*		1,005	Pool	0.45	0.50	Fines	0
8*		920	Steady	1.26	0.60	Detritus	0
9*		102	Pool	0.39	0.40	-	0
10*		56	Pool	0.84	0.40	-	0
11*		916	Pool	0.51	0.25	Detritus	0
22*		490	Pool	0.62	0.73	Boulder	0
42.4 (Trafalgar Creek)		509	Steady	1.00	0.45	Boulder	0
Open Water*		19,113	Pool	<1.00	1.00	Detritus	0
Wetlands*		51,179	Pool	<1.00	1.00	Detritus	100
12*	Dam Footprint	314	Pool	0.83	0.38	Detritus	0
43 (East Brook)	TMF	1,633	Pool	0.50	0.30	Detritus	0

* a tributary or braided reach of Seloam Brook (Figure 3).


Prepared For:
Atlantic Gold
FMS Study Area
Fisheries Resources
Trafalgar, NS
Figure: 3
Potential Direct HADD
Potential Indirect HADD
Flow Reduction
Flow Increase
Schedule 2 Determination by ECCC April 2020
Provincially Regulated Watercourse
Field Delineated Wetlands within FMS Study Area
NSE Wetlands outside FMS Study Area
FMS Study Area
FMS Planned Infrastructure
Diversion channel
water control structure
Pit
Plant
Truck Shop
Crusher Pad
ROM pad
Water Treatment
Plant and Admin Building Footprint
Seloam Diversion Berm
Tailings Management Facility
TMF pond
Topsoil Stockpile
Organics Pile
TillStockpile
Low Grade Stockpile
WRSA (NAG)
WRSA (PAG)
Access Road
Haul Road
Contractor Laydown Area
Outflow Channel
Water Management Pump
Water Management Pond
Water Management Ditch
Water Intake/Discharge Pipe
Powerline Tie In
Potential Borrow Pit
Coordinate System: NAD 1983 CSRS UTM Zone 20N
Projection: Transverse Mercator
Datum: North American 1983 CSRS
Units: Meter
0 200 400 800 m
1:16,000
Scale when printed @ 11" x 17"
Drawn By: LP
Date: 2020-07-01
Service Layer Credits:
McCallum Environmental Ltd.
Moser Lake
Seloam Brook
East Lake
East Brook
Fifteen Mile Stream
Anti Dam Flowage
540000
5000000

5.0 HADD and Schedule 2 Quantification

Fish habitat components, their function and attributes, and the fish populations that rely on them (e.g., aquatic ecosystems) are dynamic and complex. It can be more difficult, costly and uncertain to restore, enhance, or create, aquatic ecosystems than it is to avoid adverse effects in the first place. For this reason, the DFO emphasizes measures to avoid and mitigate as the preferred steps in the hierarchy of project planning, followed by measures to offset HADD as a means of last resort.

The Policy's hierarchies are listed below along with a summary of how they have been considered with this Project. The three levels include:

- Measures to Avoid;
- Measures to Mitigate; and
- Measures to Offset.

Note that the existing EIS has further details on the project, avoidance measures, mitigations, and effects assessment for Fish and Fish Habitat (Section 6.8). This information is not reproduced here but rather synthesized to bring forward key avoidance strategies, mitigations, and possible offsetting strategies related to DFO's 'hierarchy of measures.' The first two measures, avoidance and mitigation, are provided here prior to HADD quantification. Concept measures to offset the remaining HADD are provided in Section 6.0.

5.1 Measures to Avoid

Measures to Avoid for the conservation and protection of fish habitat is the first and most important step in the hierarchy of measures and therefore have been the major focus of this project to date. There have been a number of measures put in place to avoid and minimize the effects on Fish and Fish Habitat.

5.1.1 Site Plan Alternatives

As part of the early project planning and site assessment efforts, multiple site layouts were considered for both project efficiencies and the avoidance of impacts to fish frequented waters. Although components such as the open pit are fixed due to the orebody, other project footprints such as stockpiles, the TMF and road networks have some flexibility in their location. To this end, the Project team reviewed multiple locations and site plans for these features, before selecting the proposed arrangement. In some cases, this effort was dovetailed with requirements associated with the MDMER alternatives assessment for mine waste disposal. The alternatives assessment involved a review of multiple possible locations for the TMF and considered each under a variety of factors (accounts) such as environmental, socioeconomics, technical and economic considerations.

The selected, or preferred, TMF includes the location and configuration as outlined in Figure 3. To date extensive fish sampling throughout 2018-2020 have not captured fish within the TMF footprint. Additionally, environmental DNA samples collected both upstream and downstream of the barrier on WC43 supports the sampling conclusion that no fish frequent the limited standing water within the TMF boundary upstream of a natural barrier. However, due to uncertainty and data limitations at the time and the need to apply a precautionary approach; a portion of WC-43 within the TMF (Figure 3) has been determined as a potential waters frequented by Fish and will require listing under Schedule 2 of the MDMER unless it can be clearly demonstrated to not be frequented by fish. Ongoing fish collection efforts are intended to address this uncertainty.

5.2 Measures to Mitigate

Measures to mitigate any adverse effects on fish and fish habitat include both standard best practices that are implemented through all phases of the Project (e.g., construction, operation, decommissioning) and site-specific mitigation designs. Measures to Mitigate and minimize losses or reduced productivity of fish habitat have been established at several locations within the Project. Site-specific mitigation designs include the Seloam Brook realignment, habitat erosion / siltation measures, and fish relocation activities.

5.2.1 Standard Measures and Best Practices

To avoid or mitigate additional loss of waters frequented by fish or harm to fish habitat during implementation of the plan, a combination of site-specific mitigation measures as defined in permits, approvals or EA commitments and best management practices will be used. Measures and standards would include but not be limited to construction water management; erosion and sedimentation controls; and, timing windows to protect sensitive life cycle periods.

Where possible the offset and compensation measures will be constructed in advance of major Project impacts. This approach will allow for the initial development and stabilization of the works to be achieved, and significant colonization of the new replacement habitats by adjacent fish communities at the same time that fisheries impacts occur. Any changes to the approximate time periods specified in the final plan would require notification and approval by DFO in advance of the revised schedule.

A list of typical measures, standards and contingency measures that will be implemented during the Project to avoid or mitigate impacts to fish habitat are shown in Table 4.

Considering the extensive planning, the ongoing consultation with Indigenous groups and stakeholders, and the use of proven mitigation measures, AGC is confident that the Project can be constructed, operated, and rehabilitated and closed, in an environmentally responsible and safe manner that minimizes impacts to fish habitat.

5.2.2 Seloam Brook Realignment

A portion of Seloam Brook flows through the open pit location and receives drainage from the surrounding infrastructure area. To maintain creek connectivity, and to prevent flooding of the open pit, this portion of the stream will be realigned. A realignment channel approximately 800 m long will be constructed to convey flows around the north side of the proposed open pit and a proposed realignment berm. The realignment channel and berm will isolate the mine site from the watercourse, maintain fish connectivity around the project footprint, and maintain connectivity between upstream portions of Seloam Brook, Seloam Lake and WC12 to Trafalgar Creek and the lower portion of Seloam Brook (Figure 4).

Table 4: List of Measures and Standards, Success Criteria and Contingency Measures

Measure or Standard	Success Criteria	Contingency
Sediment and erosion control measures associated with the work will be in place prior to substantial ground disturbance and throughout the duration of construction	No visible sediment entering natural waterbodies as a result of ground disturbance	Stop the work that is resulting in sediment release until effective controls are implemented. Maintain supply of erosion and sediment control supplies on site to repair, replace or supplement control measures as needed.
Observe timing constraints for in-water work	Conduct in water work during preferred window (June 1 and Sept. 30)	Exemption from timing period may be requested from Regulators
Minimize duration of in-water work to the extent practicable.	Work continues in continuous manner to completion.	Monitor contractor's effort and implement additional site planning as needed. Ensure materials are available to complete the construction continuously as needed.
Undertake in-water activities in isolation of open or flowing water to avoid introducing sediment into the watercourse.	Work areas are effectively isolated from flowing water.	Stop works that are not isolated from flowing water. Isolate work area and remove fish from work area before continuing works. Maintain a sufficient supply of pumps and materials on site to isolate flows.
Follow DFO guidance on protection of fish during blasting near fish frequented waters	Maintain acceptable offsets, pressure changes and particle velocities to avoid harm to fish.	Monitor effectiveness of mitigation when appropriate offsets cannot be maintained. Adjust timing, size and timing of charges as needed.
Stabilize shoreline or banks disturbed by any activity associated with the works.	Shorelines are mostly stable and not eroding.	Grade bank to stable slope if necessary. Use temporary or permanent bank stabilization material to stabilize banks.
Remove fish from areas where waterbodies are to be abandoned or isolated from the active stream channel due to the works.	No dead or stranded fish within the work areas.	If stranded or distressed fish are observed in the work area, stop work causing distress, and continue fish removal.
Screen or use other deterrents at any pump intakes to prevent entrainment or impingement of fish as per DFO end of pipe code of practice	No fish entrained or impinged at pump intakes.	If fish are entrained or impinged, implement corrective action by, either repairing or supplementing the exclusion measure in place.
Ensure that machinery arrives on site in a clean condition and is maintained free of fluid leaks.	Machinery arrives on site in clean condition.	Have an area or location on site to clean equipment to a suitable condition on arrival or as required.
Wash, refuel and service machinery and store fuel and other materials for the machinery in such a way as to prevent any deleterious substances from entering the water.	No deleterious substances entering waterbodies.	Follow site response plan that is to be implemented immediately in the event of a sediment release or spill of a deleterious substance and keep an emergency spill kit on site.

Initial project plans involved using a simple diversion channel to provide hydraulic conveyance of flows around the open pit and through the project site; and to mitigate the fragmentation of habitat upstream and downstream of the project. Based on comments and subsequent discussions between the project team and stakeholders; AGC has decided to design an enhanced and ecologically focused channel realignment to provide additional mitigation and replacement for the affected fish habitat. The channel realignment design will include an integrated floodplain and natural channel design principles to develop highly suitable fish habitat with biological features to mitigate a large portion of the habitat losses within Seloam Brook and avoid additional HADD. Habitat design will incorporate features to mimic characteristics within the existing habitat that will be lost but will also include increased species-specific spawning habitat to provide greater productivity potential. The channel will have a better-defined flow path to improve fish passage through the reach and mitigate the braided configuration of the existing habitat, caused by past mining activities, and will utilize the consolidated flow to maximize habitat stability and suitability. The existing engineering assessment conducted during the initial diversion channel concept, shows that flows could be conveyed around the Project infrastructure within a confined realignment configuration. However, additional features such as an integrated floodplain area that would take advantage of the natural flow regime would provide increased habitat complexity and suitability as per the schematic shown in Figure 4.

The realignment will allow adequate conditions, particularly water depths for fish habitat and migration under normal flow conditions at Mean Annual Discharge (MAD) as well at 1 in 20-year Mean Annual Dry conditions. Using flows estimated at key periods within the Seloam Brook hydrologic regime (Table 5), estimates of flow and habitat conditions within the conceptual floodplain design were completed. The realignment channel configuration was based on the general outline provided in Figure 4; however, the following parameters / assumptions were also input to the design:

1. The main stream channel had to contain at least the flows expected during the (MAD) at 0.82 m^3/s.
2. The main stream channel had to contain water depths capable of fish passage during the 1:20 Annual Dry Flow at 0.28 m^3/s.
3. The overall channel slope, based on Knight-Pieshold data, was assumed to be 0.5 %.
4. The overall main channel roughness, based on Knight-Pieshold data on existing, local streams, was assumed to be 0.06.
5. The overall floodplain channel roughness, based on Knight-Pieshold data, was assumed to be 0.10.

Based on the above considerations and general main stream / floodplain configuration, the channel and floodplain design was modelled using the Wetted Perimeter Method (WPM; Newbury and Gaboury 1993) and AutoCAD to estimate water levels, water depths, and water velocities within the designed channel (Appendix A).

The AutoCAD model was run for the four flow scenarios in Table 5. Table 6 below provides the model results. The main stream channel was modified to ensure it would contain the MAD. The main stream channel was designed with a bottom width of 1.5 m and side slopes of 1:2. As shown in Table 6, an estimated flow of around 1.0m^3/s will remain within the main channel before overtopping into the floodplain. The width of the stream with this flow is estimated at 2.90 m. The model outputs also indicate that a mean water depth within the main stream will remain near 0.25-0.30 m during the 1:20 Dry Annual flow if the channel is designed similar to existing habitat.

Table 5: Realignment Flow Conditions based on Information provided by Knight-Pieshold (2020)

Flow Scenario included in Design	Inflow Location	Discharge Input (m^3/s)
1 in 20 Year Annual Dry	Seloam Reservoir (Brook)	0.22
	Southeast Inflow	0.02
	Trafalgar Brook	0.04
	Total	**0.28**
Mean Annual Flow (MAF)	Seloam Reservoir (Brook)	0.64
	Southeast Inflow	0.07
	Trafalgar Brook	0.11
	Total	**0.82**
Q10 (10-year high flow)	Seloam Reservoir (Brook)	4.8
	Southeast Inflow	2.5
	Trafalgar Brook	3.8
	Total	**11.1**
Q200 (200-year high flow)	Seloam Reservoir (Brook)	11.2
	Southeast Inflow	4.4
	Trafalgar Brook	6.6
	Total	**22.2**

Table 6: Model Output at Identified Flow Conditions within the Seloam Brook Realignment Preliminary Design

Flow Condition (m^3/s)	Estimated Model Discharge (m^3/s)	Wetted Width (m)	Mean Water Velocity (m/s)	Mean Water Depth (m)	Maximum Water Depth (m)
1:20 Dry Annual (0.28)	0.28	2.16	0.47	0.28	0.33
MAF (0.82)	1.05	2.90	0.68	0.53	0.70
Q10 (11.1)	11.32	42.19	0.49	0.55	1.53
Q200 (22.2)	22.26	44.03	0.62	0.82	1.85

Flows in excess of 1.0 m^3/s are shown to overtop the main stream channel into the floodplain. Flows as high as the 200-year event would easily be contained within the existing topography or a constructed floodplain.

Modelling of predicted flows under various scenarios provided above provides greater certainty and confirms the preliminary realignment channel can provide adequate flow capacity and habitat conditions. The preliminary design currently includes two inlet structures to convey water from the Seloam Reservoir and Trafalgar Creek tributaries (WC42) into the Realignment Channel. It will also cross a haul road where an energy dissipation pool will be constructed at the outlet of a culvert. The haul road crossing is designed to pass the 1 in 200-year flood event and the inlets, outlet, and energy dissipation pool will include riprap armor to protect against erosion during high flow events and facilitate fish passage.

The Seloam Brook Realignment Channel will be designed to provide high quality fish habitat and fish passage. Accordingly, the proposed realignment will mimic existing conditions in the surrounding watercourses to the extent practical, while alleviating some existing limitations such as the braided channels to enhance fish passage opportunities. Design considerations related to layout of habitat features and their effects on water resistance and habitat stability will be completed during final design and include habitat features proposed by stakeholders during consultation. Based on preliminary modeling results, the total estimated minimum area of realignment that would be available to fish within the existing engineered preliminary design during MAD conditions is 2,320 m^2 (800 m long x 2.9 m wide wetted width). It is currently assumed that with additional habitat features including wetland / floodplain features, this would conservatively be at least double to 4,640 m^2.

5.2.2.1 Seloam Brook Realignment Scheduling

DFO can consider and apply an offset ratio to the final HADD determination to account for uncertainties in the mitigation and offset concept options and likelihood of success as well as any delays or gaps in the timing between offset creation and the HADD occurring.

While the construction of the Seloam Brook Realignment is a mitigation to limit project based HADD, the timing is important in achieving this objective. The timing of the realignment, and therefore the fish habitat design features, will occur as one of the initial project construction activities because it will effectively realign stream flows away from other required project areas. As a result, no delay or gap in fish habitat mitigation / offset and habitat loss is anticipated. In fact, the fish habitat within the realignment will be constructed and completed prior to the majority of HADD activities.

5.2.3 Flow Management

To minimize potential erosion of existing fish habitat downstream of the Seloam Brook Realignment Channel outflow, flow control structures are being designed to reduce water velocity, and therefore scour energy, as flows enter the downstream north and south channels of Trafalgar Creek (Golder 2020). The preliminary design of the channel account for water control structures that will not only moderate flows and control downstream flow energy but will also maintain connectivity. The control structures will take the form of constructed riffles, adding additional spawning habitat features into the overall design.

The majority of the habitat being lost within the Project area consists of wider, deep pools and areas of floating emergent vegetation, typical of very low-gradient, open water / wetland habitat (Table 3). While the Habitat Suitability Indices for the fish species life stages that currently reside within the Project area are low for these habitat types, they do offer habitat complexity and some habitat refuge capacity during low-flow seasonal periods. Therefore, consideration is being given to providing similar habitat in the area of the Realignment Channel outflow that will mimic these conditions through proper placement of the flow control structures (riffles) and design of expanded low-gradient, open water / wetland habitat. While the open water / wetland habitat being lost within the Project area consists of fine organic substrates and deeper water, habitat at the Realignment Channel outflow can be constructed that will have more suitable habitat features but still mitigate a portion of open water / wetland habitat being lost within the same watershed / ecological unit.

The existing wetland complex currently experiences water level fluctuations on an annual basis due to management of the NSPI dam infrastructure on Seloam Lake. As a result, these existing wetlands are able to manage and have adapted to fluctuating water conditions. Proper placement of water control structures within Trafalgar Creek downstream of the Realignment outflow can cause strategic backwater effects (ponding) on the upstream side. Based on current placement and modelling (Appendix B – Golder Seloam Realignment Hydraulic Modelling Memorandum), existing downstream wetlands can be expected to experience flooding to a maximum, steady state depth of approximately 0.4 m, as modelled for mean average discharge rates with the addition of conceptual flow restrictions during operations.

Through ongoing design considerations, mitigation features such as proper depth excavations and larger shoreline and bottom substrates could increase suitability of any large, low-lying areas. The location of the water control structures will be finalized with the concept of maintaining downstream stability and maximizing upstream open water / wetland habitat mitigation without incurring additional HADD and reducing the amount of HADD resulting from the loss of existing channels in the open pit area. Based on modeling results, the total estimated area of additional open water / wetland that could be developed by this measure is approximately 84,449 m^2.

5.2.4 Fish Relocation

Locations requiring fish relocation include those sections of Seloam Brook as well as adjoining tributaries within the Project area / infrastructure will be identified prior to construction. The following outlines the general tasks required to complete the capture and relocation of fish.

5.2.4.1 Permitting

Upon issuance of an authorization under section 35 of the *Fisheries Act*, general permits required for fish relocation include an experimental license from DFO to handle fish, and a relocation permit to move fish from one waterbody to another (particularly if transfers are required outside the fish's resident watershed). Within the Project area, all fish can be relocated to other portions of their resident watershed. Given the numbers of fish captured in baseline habitat characterization, numbers of fish are anticipated to be low; and such it is expected that the adjacent waterbodies can accommodate the numbers of transferred fish.

5.2.4.2 Tributary Isolation and Relocation

Barrier netting typically used in stream population estimates will be erected at the mouths of each tributary and left in place throughout activities to keep the tributaries isolated. Once isolated, electrofishing will be completed throughout each to capture and remove fish. Fish will be collected in aerated coolers and transported to the release location. Efforts in deeper steadies will include the use of fyke nets, eel pots, and minnow traps (shallow-water traps), as well as angling to capture fish. Fishing gear will be set by experienced personnel using standard techniques outlined in standard work instructions and training. Gear will be checked regularly and reset such that an estimate of depletion can be determined.

5.2.5 Mitigation Monitoring

Monitoring of standard mitigations described above are to be outlined in the Project Environmental Management System (EMS) Framework Document and associated Environmental Protection Plan (EPP) which will be in place prior to construction activities to minimize possible disturbances of fish and fish habitat. To ensure that the measures and standards described are implemented as proposed, AGC onsite monitors (or designates) will monitor construction and implementation of this plan. Monitoring will clearly defined in the final offset plan, and DFO Authorizations, and be reported to DFO in an "as constructed" report provided following the works being completed. The "as constructed" monitoring report will document the construction of the offset and works as per the approved plans, and a summary of the mitigation measures and any contingency measures implemented to prevent further impacts to fish habitat. A detailed photographic record will be taken during implementation of the plan using consistent vantage points prior to, during and post construction.

5.3 Measures to Offset

A summary of the likely residual HADD and Schedule 2 habitat quantification is provided below. Standard mitigations as well as project-specific avoidances and redesigns have minimized the HADD to only those habitats where avoidance and further mitigation is not possible. It is understood that the final HADD determination will be provided by DFO; however, this preliminary quantification is provided to show that the offset concepts described in Section 6 can be designed to meet HADD quantity expectations, including any offset ratios.

5.3.1 Project Footprint (Section 35 HADD)

Using the identified fish species currently known to utilize this habitat, Habitat Suitability Index (HIS) values were generated for each species life stage using DFO data for water velocities, water depth, substrate, and where appropriate, emergent vegetation (Table 7). Using these suitabilities, the final Habitat Equivalent Units (HEUs) for the lost habitat were generated (Table 8) with the highest species life stage HEU value used to conservatively represent the overall HEU and therefore the HADD. The HADD value for each habitat type is provided in Section 6.1.

5.3.2 Project Footprint (Potential Schedule 2)

Extensive field investigations have not identified fish presence within the footprint of the Proposed TMF. However, correspondence with Environment and Climate Change Canada (ECCC) have indicated that a portion of WC-43 may be considered a waterbody frequented by fish, and as such would require listing in schedule 2 of the MDMER, unless additional fish sampling can clearly demonstrate that fish are not present at any time. The habitat within the TMF boundary and that portion of just outside the boundary estimated to be dewatered due to the TMF is a total of 1,947 m^2 as shown in Table 3. Using the identified fish species currently known to utilize this habitat, Habitat Suitability Values were generated for each species life stage (Table 9). Using these suitabilities, the final Habitat Equivalent Units (HEUs) for the lost habitat within the TMF were generated (Table 10) with the highest species life stage HEU value used to conservatively represent the HEU and therefore the HADD. The HADD value for habitat types within the TMF is provided in Section 6.1.

5.3.3 Downstream Effects

With the mitigations described above related to the Seloam Brook Realignment Channel to maintain water flows through the lower portions of the north and south channel of Trafalgar Creek and the flow energy control structures at the outflow of the realignment channel, no harmful downstream effects to fish and fish habitat are anticipated beyond the Project area.

Flow reduction will occur from the Project due to drainage area reduction in two tributaries; WC2 and East Brook (see green highlighted tributaries in Figure 3), and it is expected that the reduction in flow will be approximately equal to the quantity of drainage area reduction due to the Project. For the purpose of the

EA the project has used a threshold of 25% flow reduction as an indication of whether harmful alteration (HADD) will occur. Any area with a reduction of 25% or greater have been conservatively identified as being impacted for resident fish and the total area fully included in the HADD quantification. However, the quantity of habitat alteration due to a decrease or increase in flow would not cause complete habitat loss, and we anticipate that this value will be adjusted in future versions of this plan to account for more detailed analysis. For example, estimates of any reduced flow on fish habitat will be completed using methods such as Wetted Perimeter analysis which calculates a flow reduction whereby any further decreases would cause severe habitat reductions (point of inflection).

5.3.4 Habitat Connectivity

Habitat connectivity between the fish habitat on the upstream and downstream areas of the Project area will be maintained with the installation of the Seloam Brook Realignment Channel along with biological features to assist in habitat utilization and migration. Therefore, no connectivity effects are anticipated.

Table 7: Summary Habitat Suitability Indices for each Species Life Stage within the Project Infrastructure Footprint Area

Habitat	Brook Trout				White Sucker				Lake Chub				Pearl Dace			
	Spawning	YOY	Juvenile	Adult	Spawning	YOY	Juvenile	Adult	Spawning	YOY	Juvenile	Adult	Spawning	YOY	Juvenile	Adult
Pool	0.13	0.24	0.28	0.32	0.08	0.35	0.01	0.49	0.34	0.34	0.10	0.28	0.03	0.03	0.03	0.03
Rapids	0.13	0.40	0.42	0.41	0.15	0.70	0.00	1.00	0.71	0.71	0.21	0.42	0.20	0.20	0.20	0.20
Riffle	0.15	0.22	0.42	0.27	0.08	0.42	0.04	0.84	0.58	0.65	0.21	0.42	0.02	0.02	0.02	0.02
Steady	0.19	0.31	0.36	0.45	0.10	0.29	0.07	0.36	0.31	0.42	0.17	0.36	0.06	0.06	0.06	0.06
Open Water	0.25	0.00	0.00	0.25	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Wetlands	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Table 8: Summary of Habitat Equivalent Units for each Species Life Stage within the Project Infrastructure Footprint Area

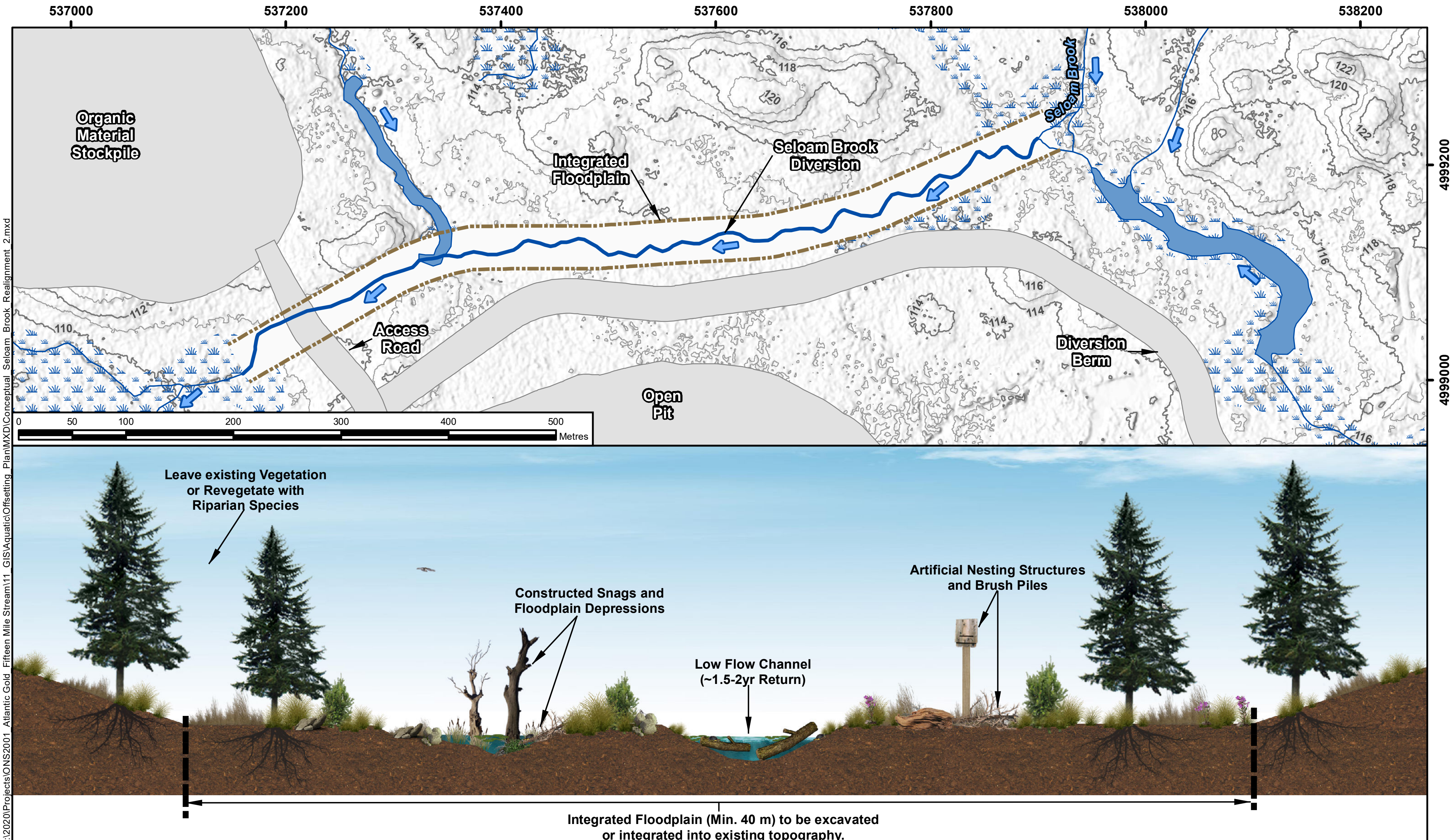
Habitat	Existing Habitat Area	Brook Trout				White Sucker				Lake Chub				Pearl Dace			
		Spawning	YOY	Juvenile	Adult	Spawning	YOY	Juvenile	Adult	Spawning	YOY	Juvenile	Adult	Spawning	YOY	Juvenile	Adult
Pool	2569	341.6	622.7	713.3	830.8	196.1	893.9	16.1	1257.6	861.8	861.8	249.2	713.3	75.8	75.8	75.8	75.8
Rapids	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Riffle	397	59.1	88.5	165.9	105.3	32.0	168.4	17.7	331.8	231.1	260.0	82.9	165.9	9.6	9.6	9.6	9.6
Steady	5368	1036.6	1689.0	1922.3	2397.5	517.3	1578.2	355.8	1922.3	1688.0	2260.7	937.1	1922.3	306.7	298.6	298.6	298.6
Open Water	19113	4730.5	0.0	0.0	4730.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Wetlands	51179	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total	78626.0	6167.7	2400.2	2801.4	**8064.1**	745.4	2640.5	389.6	3511.6	2781.0	3382.6	1269.3	2801.4	392.1	383.9	383.9	383.9

Table 9: Summary Habitat Suitability Indices for each Species Life Stage within the TMF Footprint Area

Habitat	Brook Trout				White Sucker				Lake Chub				Pearl Dace			
	Spawning	YOY	Juvenile	Adult	Spawning	YOY	Juvenile	Adult	Spawning	YOY	Juvenile	Adult	Spawning	YOY	Juvenile	Adult
Pool	0.13	0.24	0.28	0.32	0.08	0.35	0.01	0.49	0.34	0.34	0.10	0.28	0.03	0.03	0.03	0.03
Rapids	0.13	0.40	0.42	0.41	0.15	0.70	0.00	1.00	0.71	0.71	0.21	0.42	0.20	0.20	0.20	0.20
Riffle	0.15	0.22	0.42	0.27	0.08	0.42	0.04	0.84	0.58	0.65	0.21	0.42	0.02	0.02	0.02	0.02
Steady	0.19	0.31	0.36	0.45	0.10	0.29	0.07	0.36	0.31	0.42	0.17	0.36	0.06	0.06	0.06	0.06
Open Water	0.25	0.00	0.00	0.25	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Wetlands	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Table 10: Summary of Habitat Equivalent Units for each Species Life Stage within the TMF Footprint Area

Habitat	Existing Habitat Area	Brook Trout				White Sucker				Lake Chub				Pearl Dace			
		Spawning	YOY	Juvenile	Adult	Spawning	YOY	Juvenile	Adult	Spawning	YOY	Juvenile	Adult	Spawning	YOY	Juvenile	Adult
Pool	1954	258.89	471.95	540.57	629.64	148.62	677.51	12.17	953.10	653.16	0.00	188.87	540.57	57.42	0.00	0.00	0.00
Rapids	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Riffle	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Steady	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Open Water	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Wetlands	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total	1954	258.89	471.95	540.57	629.64	148.62	677.51	12.17	**953.10**	653.16	0.00	188.87	540.57	57.42	0.00	0.00	0.00



P:\2020\Projects\ONS2001 Atlantic Gold Fifteen Mile Stream\11 GIS\Aquatic\Offsetting Plan\MXD\Conceptual Seloam Brook Realignment 2.mxd

LEGEND

- Seloam Brook Diversion Channel (Representative - Design to be Developed)
- Integrated Floodplain
- Proposed Mine Feature
- Watercourse
- Waterbody
- Wetland
- Major Contours (2 metre intervals)
- Minor Contours (1 metre intervals)
- Flow Direction

NOTES:
- Proposed site plan layout provided by Knight Piésold Consulting, June 18, 2020.
- Topogarphic base data extracted from Nova Scotia GeoPortal.

Datum: NAD83
Projection: UTM Zone 20N

N W E S

Atlantic Gold
A St Barbara Ltd Company

wood.

FIFTEEN MILE STREAM GOLD PROJECT

Conceptual Seloam Brook Channel Realignment

PROJECT N°: ONS2001	FIGURE: 4
SCALE: AS SHOWN	DATE: August 2020

6.0 Conceptual Habitat Offsets

The Project would result in the permanent loss of fish habitat and its associated productive capacity, through a portion of Seloam Brook and additional tributaries within the Project area. Proven techniques in similar geographic settings for similar fish species provide the greatest likelihood of offsetting lost productive capacity for the long term, are least likely to fail structurally, and require the least amount of maintenance. Low-risk options that are biologically relevant were prioritized during the development of this Concept Offsetting Plan.

The technical feasibility of the proposed offsetting options was assessed in consideration of the site conditions present, including topography, geomorphology, hydrology, site accessibility, and the type of physical works proposed.

The current assumption is that a minimum 1:1 gain-to-loss ratio of Habitat Equivalent Units is necessary to satisfy DFO's Fish and Fish Habitat Protection Policy Statement guidance; and, that this ratio will increase to account for any uncertainties with the offset measures or time lags between habitat losses and offsets. Greater fish habitat offsetting ratios may also be required if the offsetting plan includes options that utilize techniques with long lag-times before they become fully functional. Equivalency of the proposed offsets is also considered relative to the productivity, importance, and quality of net fish habitat losses identified in the HADD determination.

The information below is a list of preliminary information and strategies to offset remaining HADD after measures to avoid and mitigate have been accounted. Preferred offsetting options will be further refined based on discussions with DFO and relevant stakeholders during the detailed offset planning process. It is also possible that alternative approaches not listed could be integrated into any Final Authorization Application (via an offsetting Plan) if required. The offsetting alternatives provided below have been developed consistent with DFO's guidance Policy for Applying Measures to Offset Adverse Effects on Fish and Fish Habitat Under the *Fisheries Act* (hereafter this Policy).

6.1 Residual Offset Requirements (HADD)

Efforts have been made to minimize residual effects of the Project on fish and fish habitat and to avoid HADD wherever possible (Section 5). However, portions of Project infrastructure will result in the loss of existing fish habitat that is currently utilized by resident fish species. Table 9 provides a summary of the quantity of fish habitat to be lost by the project, its calculated Habitat Equivalent Units, mitigation habitat used to reduce overall habitat losses (and its Habitat Equivalent Units), and the overall residual habitat losses. Note that Table 9 reflects a large area of open water developed by the channel and flow realignment / management, and that additional discussion with DFO will be required to determine the final offsetting ratio required for the project.

6.1.1 Offset Concepts

Conceptual offset planning has begun to enable DFO and others to assess the alternatives for feasibility and acceptability. Provided below are several concepts that have been considered feasible at the concept stage and, based on habitat needs of resident species and experience on similar offset designs, have a high degree of successfully being implemented.

Several concepts have been identified for preliminary assessment. Each was assessed using a ranked scale (Table 10) across numerous categories that describe various aspects of option feasibility (Table 11).

Potential options were evaluated by consideration of multiple criteria including:

- Adherence to DFO's principles and policy for offsetting;
- Location within the Seloam Brook watershed and close to the Project site;
- Self-sustaining;
- Technically feasible and economically viable; and
- Provide similar "in-kind" habitat as an offset.

The identified potential offsetting concepts (Tables 12, 13 and 14) were developed without detailed consultation with Indigenous Groups, agency, or public groups and are therefore considered preliminary; however, the options identified conform to the criteria and provide offset habitat located within the same ecological unit / watershed and provide habitat types and suitabilities similar to the habitat being lost.

6.2 Alternative 1 - Seloam Brook Realignment Channel

The biological habitat design of the Seloam Brook Realignment Channel will provide suitable habitat features for spawning, rearing and migration. The concept has been previously described as a mitigation measure in Section 5.2.2. It is carried into this section as it directly affects the quantity of HADD that will require offsetting.

6.3 Alternative 2 – Onsite Open Water Habitat

Similar to the creation of open water habitat within the mitigation described in Section 5.2.3, additional off-channel habitat would be constructed within the Seloam / Trafalgar Brook ecological unit. While the exact locations require further investigation of geotechnical, hydrogeological, and terrain constraints, the general description has been provided below.

The Seloam Brook habitat improvements are proposed downstream of the realignment channel and flood area described in Section 5.2.3. The proposed concept is to install rock weir riffle enhancements immediately downstream of all mitigation structures and excavate ponds as off-channel habitat adjacent to the existing channel. The proposed objective is the creation of at least 6,300 Habitat Equivalent Units of high-quality pond and stream habitat to offset a portion of the remaining habitat units lost related to existing stream and open water habitat within the Project infrastructure footprint and TMF. The exact locations of the measure will need further adjustment to reflect ongoing flow modeling efforts, but sufficient areas exist adjacent to the Project to provide a high degree of certainty for this alternative.

The rock weir riffle enhancements will require the addition of coarse rock and fine gravel to create a riffle pool type stream profile along the existing channel reach. Riffle pool spacing would be determined at the next stage of design once additional site information is collected. The stream reach would be suitable for rearing by several species and potential spawning by Brook Trout and White Sucker.

The benefits and uncertainty associated with the proposed pond offsetting measures are primarily associated with the low-lying areas where they would be most effectively created. Typically, by mid-summer it is assumed that the water levels in the stream will be lower than the surrounding low-lying areas, and that material can be removed without direct interference from flows in the adjacent creek. Construction requires the installation of a berm along the margins of the channel to allow machine access. The limitations to construction involve the stability of these margins and their potential to support heavy machinery. Constructing the ponds without heavy machinery is considered unfeasible. Alternatively, excavations could occur during the winter months when travel across frozen ground would reduce impacts of heavy machinery, minimize the need for berm / access construction, and allow easy removal of frozen material, particularly in low-lying areas where the water table would cause possible issues for excavation / removal.

Constructing the rock riffle weirs without heavy machinery is also considered unfeasible. Similar to open water excavations, access and placement of rock weirs during the winter months is possible if proper surveys are completed prior to snow / freeze up. This method has been conducted in other offset constructions and avoids the need to remove riparian vegetation, heavy equipment access clearing / construction, and costly revegetation activities.

Further investigations would be required, if deemed an appropriate concept, to finalize the design. The concept is also easily scalable to cover larger, or smaller, areas, if required providing adequate locations are accessible and within Atlantic Mining Nova Scotia Inc.'s land tenure.

6.4 Alternative 5 - Complementary Measures

Measures to improve existing fisheries knowledge in areas of interest to Indigenous communities could provide information related to possible future habitat rehabilitation options, additional habitat utilization, and/or species distributions / movement patterns in Nova Scotia, particularly in areas near the Project. The exact format of complementary measures will depend on consultations between Atlantic Mining Nova Scotia Inc. representatives and local Indigenous communities. While complementary measures are typically limited to a maximum of 10% of the offset plan, this option can provide additional avenues for alternative offset options. As shown in Table 12, this alternative was ranked as third highest due to its flexibility and ability to align with specific interests of stakeholders.

6.5 Alternative 3 - Offsite Open Water Habitat

Open water habitat creation is a well-known, successful method used in numerous offset plans to provide suitable young-of-year, juvenile, and adult habitat for most of the species identified within the Project footprint. Other local species may also utilize the habitat for spawning. The same concept and general methodology described for onsite (Section 6.3) could be applied to other locations offsite (i.e., outside the Selaom / Trafalgar Brook ecological unit), should it be required or should it be deemed more beneficial to fish populations in other locations than those near the Project area. This offsite alternative was ranked lower due to greater risks and challenges related to land tenure and not being a direct benefit within the watershed(s) being affected by the Project.

6.6 Alternative 4 and Alternative 6

Additional options (Alternatives 4 and 6) investigated included the rehabilitation / restoration of degraded aquatic habitats both within and beyond former mining areas including old stream realignments, dewatered / infilled stream reaches, and man-made barriers. Restoration methods are well-known and can be very successful if used in the proper location. Discussions with groups involved in the planning of remediation of former mining areas indicate that additional coordination may be challenging due to land tenure challenges and liabilities; however, alternate locations may be identified through consultations with local stakeholders and Indigenous communities. These would be considered if required; however, are a lower overall ranking due to numerous uncertainties with their implementation.

Table 11: Summary of Habitat Lost and Mitigations for FMS Project Infrastructure Footprint and TMF

Habitat Measure	Project Area	Habitat Type	Total Habitat Area (m^2)	HEU (m^2)	Description
Lost	Infrastructure Footprint	Stream	8,334	3,333	Highest Habitat Equivalent Unit for adult Brook Trout
		Open Water	19,113	4,730	Highest Habitat Equivalent Unit for both spawning and adult Brook Trout
		Wetland	51,179	0	No Habitat Equivalent Unit value
	TMF	Stream	1,947	953	Highest Habitat Equivalent Unit for adult White Sucker
		Open Water	0	-	No open water habitat present
		Wetland	0	-	No wetland habitat present
Total			**80,573**	**9,016**	
Mitigation	Realignment	Stream	4,640	4,640	Will be designed as suitable for all species present within the footprint
	Flood Area	Open Water	84,449	20,901	Will be designed as suitable as possible for all species present with adult Brook Trout as the habitat template
		Wetland	0	-	No emergent vegetation habitat will be designed or constructed
Total			**89,089**	**25,541**	
Residual HADD				**-16,525**	Net increase in Habitat Equivalent Units with the development of appropriate mitigations

Table 12: Ranking Scale Legend for Candidate Fish Habitat Offset Options

Rank Scale	Rank Meaning	Rank Definition
1	Very Low	Very Low feasibility and/or certainty of the proposed offset alternative relative to the specific category
2	Low	Low feasibility and/or certainty of the proposed offset alternative relative to the specific category
3	Moderate	Moderate feasibility and/or certainty of the proposed offset alternative relative to the specific category
4	Moderate to Good	Moderate to Good feasibility and/or certainty of the proposed offset alternative relative to the specific category
5	Good	Good feasibility and/or certainty of the proposed offset alternative relative to the specific category
6	Very Good	Very Good feasibility and/or certainty of the proposed offset alternative relative to the specific category

Table 13: Definition of Categories for Candidate Compensation Concept / Options

Categories	Definition
Overall rank	Rank is order of highest cumulative ranking scores (an overall rank of 1 being the highest or more likely feasible alternatives).
Alternative	Description of alternative, representing the type of alternative (i.e., channel realignment, new pond basin, existing habitat enhancement).
Simplicity of concept and pre-design info needs	Simplicity ranking, with 1 being the least simple and 6 being the simplest. Lower rankings will require more extensive field programming, modelling, engineering design, and/or time to obtain necessary pre-design information.
Monitoring simplicity and success certainty	Monitoring success simplicity ranking, with 1 being the least simple and 6 being the simplest. Effort required to establish certainty of project success through monitoring.
Operational relevance	Relevance to facilitation of project site development. High relevance (e.g., 6) means the alternative also facilitates site infrastructure development.
Compatibility with existing land use	Brief description of existing land use and proposed offsetting alternative feasibility / compatibility with this land use type. Proposed offset alternative relevance to the existing land use, habitat type or fishery. High compatibility (e.g., 6) means the alternative is highly compatible with existing land use.
Habitat area gain - portion of constructed or restored habitat credited to offset balance	The proportion of the total area required to be compensated that the specific alternative can provide. New habitats receive highest values (100%= very high) while habitat enhancement may only receive partial credit.
Habitat area gain – percent of total offset amount required	The percent of the total area required to be compensated that the specific alternative can provide. This percent can be broken up into two groups: watercourse % and waterbody %. Higher values are awarded to larger alternatives.
Construction implementation and required controls	Level of controls and implementation required during the specific alternative construction to prevent additional environmental damage. Higher values are awarded where fewer controls are needed
Construction certainty	Feasibility of constructing the specific offset alternative, including access to the offset location and terrain type. High certainty (e.g., 6) means the constructability is highly certain.
Land tenure certainty	Certainty that Proponent will have tenure of the lands proposed to be included in the specific offsetting alternative. High certainty (e.g., 6) means the lands are under control of Proponent.
Relative cost per type of offset measure	Cost of the specific offset alternative relative to other proposed alternatives within the matrix. High relative cost (e.g., 1) means the cost is higher then other alternatives.
Stakeholder interest (aligns with interests of several groups, increases Diversity of fish community *	How well the specific offset alternative aligns with the interests of different stakeholder groups and provincial management objectives. Higher values are awarded to alternatives with high stakeholder alignment.
Cumulative score (highest is most preferred)	Cumulative score of the specific offset alternative using the rank scale (Table 10).

* Stakeholder interest is preliminary based on regulatory guidance and anticipated community interest. This ranking will need to be confirmed during consultation efforts.

Table 13: Candidate Compensation Concept / Options Matrix

Overall Rank	Alternative	Simplicity of Concept and Pre-design Information Needs	Monitoring Simplicity and Success Certainty	Operational Relevance	Compatibility with Existing Land Use and Ecological Relevance	Habitat Area Gain		Construction Implementation and required controls	Construction Certainty	Land Tenure Certainty	Relative Cost per Type of Compensation / Offset Measure	*Stakeholder Interest (Aligns with Interests of Several Groups, Increases Diversity of Fish Community)	Cumulative Score (Highest is Most Preferred)
						Portion of Constructed or Restored Habitat Credited to Compensation / Offset Balance	Percent of Total Compensation Amount Required						
1	Note: This alternative is considered mitigation and not an offset Alternative 1 Required Watercourse Realignments: Seloam Brook	Very Good (6) Realignments are common practice. Basic Fisheries and engineering values needed from Reference Habitat to replicate habitat. Most information is available or readily obtainable.	Very Good (6) Monitoring is simple and relies on comparison to baseline reference values. Relatively short duration 3-10 years. Similar habitat should have similar fish values.	Very Good (6) (simple diversion channel required to divert water around Open Pit and to maintain downstream flow to brook. Additional design features can be readily integrated to convert the diversion concept into a full ecologically functional realignment channel with integrated floodplain.	Land Use Good (4) Mostly wetland and existing aquatic corridor. Ecological Relevance Very Good (6) High relevance as realignment channel will connect to and potentially enhance permanent water features, maintaining fish passage within watershed.	Very Good (6) Nearly 100 % of the realigned channel should be credited to the Plan **as mitigation credit.** May result in additional Mitigation or Offset "Habitat Units" by addressing limiting conditions of existing channel. Any existing fish bearing waters in the alignment may only receive partial credit.	Good (5) The realignment can be used to mitigate total impact area / habitat units but requires confirmation of ratio of mitigation with DFO. Estimated Habitat Equivalent Units within the realignment channel, using appropriate habitat features is 5,600 m^2.	Moderate to Good (4) Sizeable drainage area results in larger water management needs. Existing creek flows will need to be bypassed during construction. Can use existing channel and construct most of the new alignment in isolation with cofferdams.	Good (5) Good access to site via site roads and planed infrastructure. New channel construction is relatively common and predictable. Actual new alignment is in soft wetland terrain and will require winter construction and or a new construction access road.	Very Good (6) All areas are under control of Proponent.	Moderate (3) Cost per unit of creek realignment is high, but cost of open water from inundation is low.	Moderate to Good (4) Option is in immediate project area as per preferences of DFO. Other stakeholders require further consultation, but concept has been previously proposed in Project documents. Includes sportfish potential (Brook Trout) but access may be limited for recreational purposes.	60
2	Alternative 2 Excavate new open water Basins on site. Online open water constructed in Seloam Brook Downstream of the Realignment Channel, or elsewhere on AGC lands	Good (5) Pond development is simple concept. Basic Fisheries and engineering values needed from reference lakes to replicate habitat. Most information is available or readily obtainable. Engineering studies required to predict ground conditions and hydraulic suitability.	Good (5) Monitoring is simple and relies on comparison to baseline reference values. Relatively short duration 3-10 years. Similar habitat should have similar fish values.	Low (2) Not required to facilitate project site development.	Land Use Good (4) Mostly wetland. Some terrestrial land use is affected. Ecological Relevance Good (5) Options to improve deficiencies in existing habitat, particularly locally affected species.	Very Good (6) 100 percentage of the new basin should be credited to the compensation.	Very Good (6) Large areas available and can most likely provide 100% of required area	Good (5) New basins can be constructed in isolation and filled prior to connection. Excavations and habitat placements within new pond footprint will require moderately complex sediment and erosion control planning to protect existing waterbody (e.g., downstream brook and lake) during construction.	Good (5) Good access to site via site roads and planed infrastructure. New pond construction is relatively predictable. Alignment is in soft wetland terrain and may require winter construction and or a new construction access road. Material disposal is assumed possible in existing mine impoundment areas.	Very Good (6) Areas are under control of Proponent. Options may require third party agreement.	Moderate (3) Waterbody / pool construction cost is Moderate.	Moderate to Good (4) Option is in immediate project area as per preferences of DFO. Includes sportfish potential (Brook Trout) but access may be limited for recreational purposes	56

Overall Rank	Alternative	Simplicity of Concept and Pre-design Information Needs	Monitoring Simplicity and Success Certainty	Operational Relevance	Compatibility with Existing Land Use and Ecological Relevance	Habitat Area Gain		Construction Implementation and required controls	Construction Certainty	Land Tenure Certainty	Relative Cost per Type of Compensation / Offset Measure	*Stakeholder Interest (Aligns with Interests of Several Groups, Increases Diversity of Fish Community)	Cumulative Score (Highest is Most Preferred)
						Portion of Constructed or Restored Habitat Credited to Compensation / Offset Balance	Percent of Total Compensation Amount Required						
3	Alternative 5 Complementary Measures	Good (5) Measures improve existing fisheries knowledge in areas of interest to Indigenous communities. Success is measured by the collection of data and greater understanding.	Moderate to Good (4) Monitoring is simple and relies on collection and analysis of data. Duration varies depending on study. Often relies on multiple groups collaborating.	Moderate (3) Not required to facilitate project site development but topic of study may interact with the site development.	Land Use Assumed Good (5) Studies generally examine existing aquatic habitat / fisheries. Good (5) Ecological Relevance High as the measure informs management decisions and can be relevant to ongoing project activities and other projects / initiatives.	Moderate (3) Value varies - habitat credit is given up to maximum of 10% of the Offset requirements.	Low (2) Maximum of 10% of the Plan.	Good (5) Generally, has limited construction and relies on study design and sampling logistics.	Good (5) Generally, has limited construction and relies on study design and sampling logistics.	Moderate (3) Landowner likely agreeable to works but may require agreements.	Moderate (3). Generally, cost effective to conduct studies, but values may be prorated to overall plan cost.	Very Good (6) Works are generally requested / proposed by Indigenous Communities and/or public and have interest of federal gov. public and FN.	49
4	Alternative 3 Excavate new pond Basins - offsite Online Ponds constructed in adjacent waterbodies outside of AGC lands. West R. sheet Harbor?	Good (5) Pond development is simple concept. Basic Fisheries and engineering values needed from reference lakes to replicate habitat. Most information is available or readily obtainable. Engineering studies required to predict ground conditions and hydraulic suitability.	Good (5) Monitoring is simple and relies on comparison to baseline reference values. Relatively short duration 3-10 years. Similar habitat should have similar fish values.	Low (2) Not required to facilitate project site development.	Land Use uncertain (3) Ecological Relevance Moderate to Good (5) Options to improve deficiencies in existing habitat; however, additional baseline data may be required.	Very Good (6) 100 percentage of the new basin should be credited to the compensation.	Good but Uncertain (4) Large areas may be available to provide 100% of required area but requires further study.	Good (5) New basins can be constructed in isolation and filled prior to connection. Excavations and habitat placements within new pond footprint will require moderately complex sediment and erosion control planning to protect existing waterbodies during construction.	Uncertain (3) Offsite access to site via site roads is uncertain and would require further study. New pond construction is relatively predictable. Alignment may be in soft wetland terrain and may require winter construction and or a new construction access road.	Moderate (3) Options will/ may require third party agreement.	Moderate (3) Waterbody construction cost is Moderate.	Moderate (3) Works are somewhat removed from site and area of impact. Works are in area of interest and should have support of regulators, providing onsite options are not viable. Includes sportfish potential	47
5	Alternative 4 Restoration of degraded habitats in former mining areas. Includes barrier removal considerations. Possible collaboration with NS Lands	Moderate (3) Measures improve existing habitat and require detailed existing habitat values to compare to predicted values. Option has been prepared to concept level by Remedial action group (NS Lands). Requires planning and agreements with multiple groups.	Moderate (3) Post construction comparison must demonstrate that channel improvements have transferred to increased productivity. May require higher effort over 5-10 years to clearly demonstrate success. Unless physical completion is success metric.	Low (2) Not required to facilitate project site development and further removed from site.	Land Use Very Good (6) Existing channel / aquatic habitat. Very Good (6) Ecological Relevance Is high with restoration of former habitat, but option has lower certainty of ecological success.	Moderate (3) The channel is existing and only partial credit for improvement will be given and/or will be based on relative productivity increases.	Moderate (3) Creek Length/ habitat area to meet Project requirements is uncertain due to partial credit. Uncertainty related to water quality effects of former mining operations also requires consideration.	Moderate (3) Will require complex sediment and erosion control and water management planning to protect existing waterbodies during construction. May require complex schedule dependant on others (e.g., containment cells).	Good (5) Access unknow without further study. Habitat rehabilitation methods relatively standard.	Moderate to Good (4) Landowner likely agreeable to works but requires agreements.	Poor (2) Cost per unit of creek / channel is unknown but expected to be high due to contamination controls.	Good (5) Works are furthest removed from site but in area of impact. Works are in "area of concern" and have interest of federal gov. public and FN.	45

wood.

Overall Rank	Alternative	Simplicity of Concept and Pre-design Information Needs	Monitoring Simplicity and Success Certainty	Operational Relevance	Compatibility with Existing Land Use and Ecological Relevance	Habitat Area Gain		Construction Implementation and required controls	Construction Certainty	Land Tenure Certainty	Relative Cost per Type of Compensation / Offset Measure	*Stakeholder Interest (Aligns with Interests of Several Groups, Increases Diversity of Fish Community)	Cumulative Score (Highest is Most Preferred)
						Portion of Constructed or Restored Habitat Credited to Compensation / Offset Balance	Percent of Total Compensation Amount Required						
5	Alternative 6 Restoration of degraded habitats in other watersheds outside the Project Area. May include removal of fish barriers. Possible collaboration with Indigenous Groups or other NS conservation groups	Moderate (3) Measures improve existing habitat and require detailed existing habitat values to compare to predicted values. Option has not been prepared to concept level as data required would be on a location-by-location basis.	Moderate (3) Post construction comparison must demonstrate that channel improvements have transferred to increased productivity. May require higher effort over 5-10 years to clearly demonstrate success. Unless physical completion is success metric.	Low (2) Not required to facilitate project site development and further removed from site.	Land Use Very Good (6) Existing channel / aquatic habitat. Good (5) Ecological Relevance Is high with restoration of former habitat that can be focused on target recreational species, but option has lower certainty of ecological success.	Moderate (3) The channel is existing and only partial credit for improvement will be given and/or will be based on relative productivity increases.	Moderate (3) Creek Length / habitat area to meet Project requirements is uncertain due to partial credit.	Moderate (3) Will require complex sediment and erosion control and water management planning to protect existing waterbodies during construction.	Good (5) Access unknow without further study. Habitat rehabilitation methods relatively standard.	Moderate to Good (4) Landowner likely agreeable to works but requires agreements.	Moderate (3) Cost per unit of creek / channel is unknown but expected to be high; however, lower uncertainty related to possible previous contamination.	Good (5) Works are furthest removed from site but would be in an area identified as requiring rehabilitation and would have interest of federal gov. public and FN.	45

7.0 Monitoring

As part of a detailed offset plan and once the offset measures have been selected, a monitoring program will be developed in consultation with DFO; and included in the final offset plan and Fisheries Authorization.

8.0 Consultations

Engagement is a key component of Atlantic Mining Nova Scotia Inc.'s approach to the planning and implementation of its projects and other business activities. A number of engagement initiatives have been undertaken in relation to the Project, with further engagement in progress or being planned. This includes discussions with relevant government departments and agencies, Indigenous communities and stakeholder organizations.

Sections 3 and 4 of the EIS describe previous and ongoing engagement initiatives related to the Project with Indigenous groups and the public. To continue in the vein of open communications on the Project, Atlantic Mining Nova Scotia Inc. is committed to meeting with and/or providing information to stakeholders at the appropriate time to discuss any offsetting plans.

9.0 List of Supporting Documents

Armantrout, N.B. 1996. Alaska Aquatic Resources Information Management System (AARIMS), U.S. Bureau of Land Management, Anchorage, Alaska.

Armantrout, N.B. 1998. Glossary of aquatic habitat inventory terminology. American Fisheries Society, Bethesda, Maryland.

Bain, M.B. and N.J. Stevenson (eds.). 1999. Aquatic habitat assessment: common methods. American Fisheries Society, Bethesda, Maryland.

Barber, W.E., M.E. Oswood and S.J. Deschermeler. 1981. Validation of two habitat fish stream survey techniques: the area and transect methods. Final Report. U.S. Department of Agriculture, Forest Service. Ketchikan, AK. Contract 53-0109-0-00054.

Beak. 1980. Fisheries resources of tributaries of the lower Churchill River. Prepared by Beak Consultants Limited for the Lower Churchill Development Corporation, St. John's, Newfoundland and Labrador.

Bisson, P.A., J.L. Nielsen, R.A. Palmason and L.E. Grove. 1982. A system of naming habitat types in small streams, with examples of habitat utilization by salmonids during low streamflow, p. 62-73. In N.B. Armantrout (ed.), Acquisition and utilization of aquatic habitat inventory information. Proceedings of a symposium held 28-30 October, 1981, Hilton Hotel, Portland, Oregon.

Borsanyi, P. 1982. A classification method for scaling river biotopes for assessing hydropower regulation impacts. A thesis submitted to the Norwegian University of Science and Technology, Faculty of Engineering Science and Technology, Department of Hydraulic and Environmental Engineering, Trondheim, Norway. ISBN 82-471-8.

Borsanyi, P., K. Alfredson, A. Harby, O. Ugedal and C. Kraxner. 2002. A meso-scale habitat classification method for production modelling of Atlantic salmon in Norway. IFIM Users workshop, 1-5 June 2002, Fort Collins, CO.

DFO. 2006. Practitioners guide to the risk management framework for DFO habitat management staff. Vers. 1.0. http://oceans.ncr.dfo- mpo.gc.ca/habitat/home_e.asp.

DFO. 2012. Standard Methods Guide for the Classification and Quantification of Fish Habitat in Rivers of Newfoundland and Labrador for the Determination of Harmful Alteration, Disruption or Destruction of Fish Habitat (Draft). Fisheries and Oceans Canada, St. John's, NL.

Flosi, G. and F.L. Reynolds. 1994. California salmonid stream habitat restoration manual. California Department of Fish and Game, Technical Report, Sacramento.

Gosse, M.M., B. Brown, D.A. Scruton, and A. Beersing. 2001. A common approach to understanding and addressing instream flow needs in Newfoundland and Labrador. Fisheries and Oceans Canada, Internal Report. 10p + 2 app.

Grant, C.G.J. and E.M. Lee. 2004. Life history characterization of freshwater fishes occurring in NL, with major emphasis on riverine habitat requirements. Canadian Manuscript Report of Fisheries and Aquatic Sciences 2672: xii + 262p.

Hawkins, C.P., J.L. Kershner, P.A. Bisson, M.D. Bryant, L.M. Decker, S.V. Gregory, D.A. McCullough, C.K. Overton, G.H. Reeves, R.J. Steedman and M.K. Young. 1993. A hierarchical approach to classifying stream habitat features. Fisheries 18(6): 3-12.

McCain, M., D. Fuller, L. Decker and K. Overton. 1990. Stream habitat classification and inventory procedures for northern California. FHR Currents No. 1, U.S. Dept. of Agriculture, Forest Service, Pacific Southwest Region.

McCarthy, J.H., B.R. LeDrew and L.J. LeDrew. 2004. A Framework for aquatic habitat classification and quantification. Presented at the 4th World Fisheries Congress held in Vancouver, British Columbia, Canada, May 2-6, 2004.

McCarthy, J.H., C. Grant, D. Scruton. 2006. Classification and Quantification of Fish Habitat in Rivers of Newfoundland and Labrador (Draft). Fisheries and Oceans Canada, St. John’s, NL.

McMahon, T.E., A.V. Zale and D.J. Orth. 1996. Aquatic habitat measurements, p. 83-120. In B.R. Murphy and D.W. Willis (eds.). Fisheries Techniques, 2nd edition. American Fisheries Society, Bethesda, Maryland.

Minns. C.K. 1997. Quantifying “no net loss” of productivity of fish habitats. Canadian Journal of Fisheries and Aquatic Sciences 54: 2463-2473.

Morhardt, J.E. 1986. Instream flow methodologies. Report of Research Project 2194-2. Electric Power Research Institute, Palo Alto, CA. v p.

Nelson, F.A. 1980. Evaluation of selected instream flow methods in Montana. Proceedings of the Annual Conference of the Western Association of Fish and Wildlife Agencies: 412-432.

Newbury, R.W. and M.C. Gaboury. 1993. Stream analysis and fish habitat design: a field manual. Newbury Hydraulics Ltd. British Columbia, Canada.

Nickelson, T.E., J.D. Rodgers, S.L. Johnson and M.F. Solazzi. 1992. Effectiveness of selected stream improvement techniques to create suitable summer and winter rearing habitat for juvenile coho salmon (Oncorhynchus kisutch) in Oregon coastal streams. Canadian Journal of Fisheries and Aquatic Sciences 49: 790-794.

Osborne, L.L., B. Dickson, M. Ebbers, R. Ford, J. Lyons, D. Kline, E. Rankin, D. Ross, R. Sauer, P. Seelbach, C. Speas, T. Stefanavage, J.Waite and S. Walker. 1991. Stream habitat assessment programs in states of the AFS North Central Division. Fisheries 16: 28-35.

Oswood, M.E. and W.E. Barber 1982. Assessment of fish habitat in streams: goals, constraints, and a new technique. Fisheries 7(4): 8-11.

Platts, W.S., W.F. Megahan and G.W. Minshall. 1983. Methods for evaluating stream, riparian and biotic conditions. U.S. Forest Service, Inter-mountain Forest and Range Experiment Station, General Technical Report INT-138, Orden, Utah.

Appendix A

Wood Seloam Brook Realignment Section Model Results

Wood Environment & Infrastructure Solutions,
a Division of Wood Canada Limited
133 Crosbie Road
PO Box 13216
St. John's, NL A1B 4A5
Canada
T: 709-722-7023

October 9, 2020

James Millard
Manager, Environment & Community
Atlantic Mining NS Inc.
409 Billybell Way
Mooseland, Middle Musquodoboit, NS B0N 1X0
James.Millard@atlanticgold.ca

Dear James,

RE: Seloam Brook Realignment Section Model Results

As we further our fish habitat offset concept, Wood has completed preliminary flow design estimates of the Seloam Brook realignment habitat. The modelling that was completed uses existing hydrological data generated from previous diversion channel designs to estimate the flow parameters (water depth, velocity, and wetted perimeter) within the conceptual realignment channel. The estimates generated will provide greater certainty to the design team and regulators that the concept can convey the anticipated flows and can be sustainable beyond the life of mining operations.

Provided below are the results of the preliminary flow design estimates. This information will be further advanced during the detailed design work required for final Fisheries Act approvals.

Typical Seloam Brook Realignment Configuration

Initial configuration of the Seloam Brook realignment channel includes a stream channel as well as a surrounding integrated flood plain area (**Figure** 1). The concept being that the stream channel will be the primary fish habitat and will contain the anticipated principle flows while the flood plain will allow high-flow events such as spring freshets and extreme storm events to pass, similar to a natural wetland/flood plain ecosystem. The channel and floodplain would both be designed to provide substrates, morphology and cover in the high suitability range for the fish species known to exist in the system and to provide ecological function for other species of wildlife that depend on creek corridors.

Hydrology and Stream Flow Events

The flows used to design the stream channel and flood plain have been based on previous analytical work completed by Knight-Pieshold Consulting during the design of the previous Seloam Book Diversion channel which did not include a habitat-based flood plain. While the diversion was less habitat-focused, the flows estimated from historic hydrologic records and measures remain valid and were used in this revised integrated floodplain design. **Table** 1 provides a summary of the flows at typical key periods within the hydrologic regime predicted for the realignment channel. The estimated flows have been determined separately for each flow input to the realignment channel; Seloam Brook (reservoir flows), Southeast inflow, and Trafalgar Creek. While each will intersect the realignment channel at different locations, the combined flow from all inputs was included in the preliminary design as a precautionary measure to ensure that maximum predicted flows can be conveyed within the entire realignment habitat features.

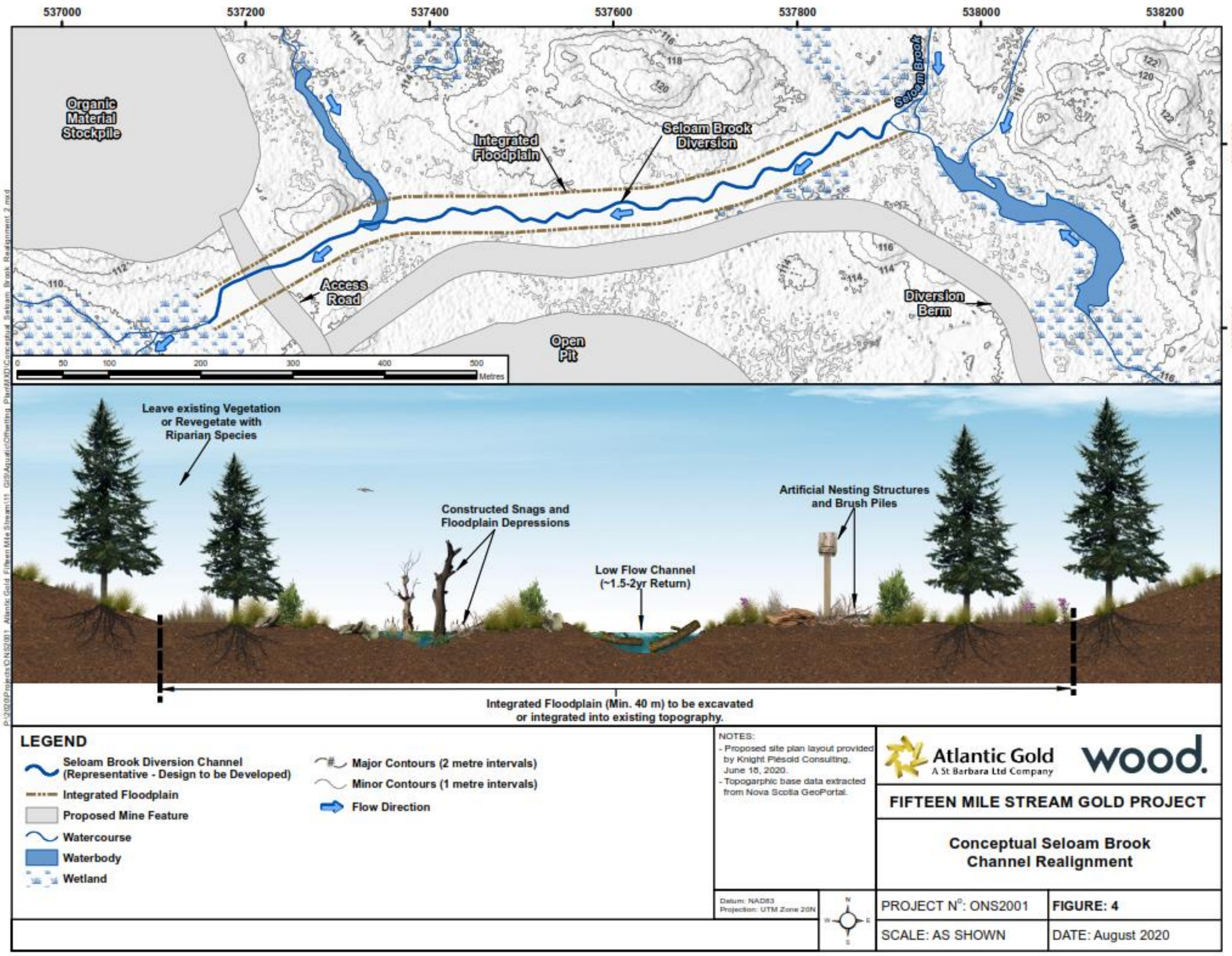


Figure 1: General stream/flood plain concept, Seloam Brook Realignment Channel.

Table 1: Realignment Flow Conditions based on information provided by Knight-Pieshold (2020)

Flow Scenario Included in Design	Inflow Location	Discharge Input (m^3/s)
1 in 20 Year Annual Dry	Seloam Reservoir (Brook)	0.22
	Southeast Inflow	0.02
	Trafalgar Brook	0.04
	Total	**0.28**
Mean Annual Flow (MAF)	Seloam Reservoir (Brook)	0.64
	Southeast Inflow	0.07
	Trafalgar Brook	0.11
	Total	**0.82**
Q10 (10-year high flow)	Seloam Reservoir (Brook)	4.8
	Southeast Inflow	2.5
	Trafalgar Brook	3.8
	Total	**11.1**
Q200 (200-year high flow)	Seloam Reservoir (Brook)	11.2
	Southeast Inflow	4.4
	Trafalgar Brook	6.6
	Total	**22.2**

Realignment Channel Considerations

The initial diversion channel design completed by Knight-Pieshold Consulting (2020) provided general conditions at the realignment location such as overall slope and measures of existing, local stream conditions. These were also incorporated into the habitat design where required.

The realignment channel configuration was based on the general outline provided in **Figure** 1; however, the following parameters/objectives were also input to the design:

1. The main stream (low flow) channel had to contain at least the flows expected during the Mean Annual Flow (MAF) at $0.82 m^3/s$;
2. The main stream channel had to contain water depths capable of maintaining fish passage during the 1:20 Annual Dry Flow at $0.28 m^3/s$;
3. The overall channel slope, based on Knight-Pieshold data, was assumed to be 0.5%;
4. The overall main channel roughness, based on Knight-Pieshold data on existing, local streams, was assumed to be 0.06;
5. The overall flood plain channel roughness, based on Knight-Pieshold data, was assumed to be 0.10.

These parameters are considered reasonable metrics for assessment of the conceptual channel. An updated detailed flow model will be further developed during detailed design to support the approvals process and to refine the habitat design.

Realignment Channel Configuration and Modelling

Based on the above considerations and general main stream / flood plain configuration, the channel and flood plain design was modelled. The Wetted Perimeter Method (WPM; Newbury and Gaboury 1993) was used in AutoCAD to model water levels, water depths, and water velocities within the designed channel.

The WPM is a fixed flow hydraulic rating method based on the hydraulic relationship between flow (i.e. discharge) and wetted river perimeter at selected transect(s) (Stalnaker et al. 1994). Using the relationship, the flow corresponding to a wetted perimeter (wetted width of the stream cross section), can be estimated using Manning's equation. The equation was applied to the key flow periods in **Table** 1 to estimate habitat conditions. Manning's equation is given by

$\text{Velocity (m/s)} = R^{2/3} * S^{1/2} / n$ where

R = Hydraulic radius (Area (m^2) / wetted perimeter (m))
S = stream slope at transect
n = Manning's n.

The equation assumes that the transect used to represent the habitat is a suitable index of habitat for the full stream.

An AutoCAD realignment cross section was created (**Figure** 2) to model flow conditions. Using Manning's equation, the habitat conditions were simulated. Modelled values of wetted width (m), mean water velocity (m/s), and mean / maximum water depths (m) were estimated. Based on data from Knight-Pieshold Consulting (2020), mean channel slope (S) was input at 0.005 (i.e., 0.5% slope) and Manning's roughness values for the main channel (n) were input at 0.060 with the flood plain roughness at 0.100. To estimate conditions during flood periods, the Manning's value was estimated using a weighted mean of the two roughness values and the relative proportion of the wetted area within each habitat type (n = 0.096).

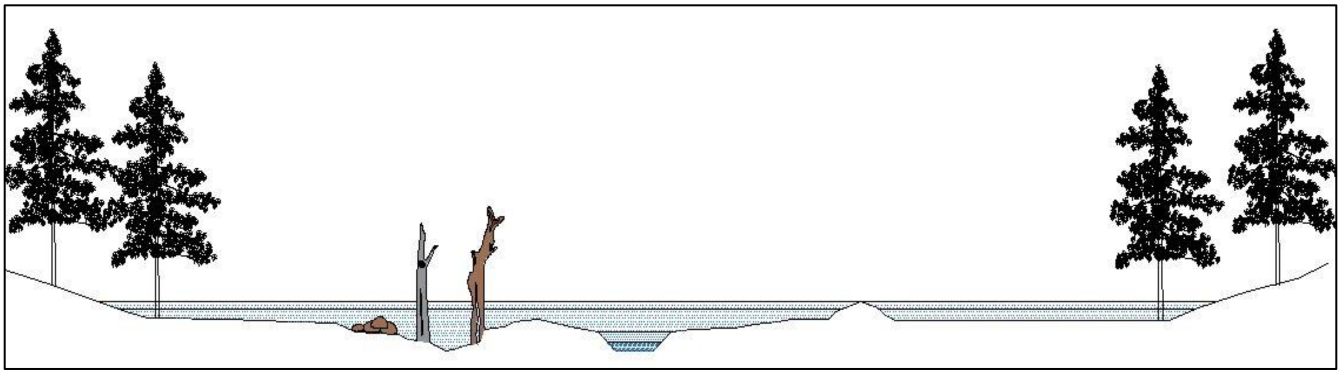


Figure 2: AutoCAD profile of Seloam Brook Realignment.

Model Results

The AutoCAD model was run at the four design flow scenarios in **Table** 1. **Table** 2 below provides the model results. The main stream channel was modified to ensure it would contain the MAF. The main stream channel was designed with a bottom width of 1.5m and side slopes of 1:2. As shown in **Table** 2, an estimated flow of around 1.0m^3/s will remain within the main channel before overtopping into the flood plain. The width of the stream at this flow is estimated at 2.90m. The model outputs also indicate that a mean water depth within the main stream channel will remain near 0.25-0.30m during the 1:20 Dry Annual flow if the channel is designed similar to existing habitat.

Flows in excess of 1.0m^3/s are shown to overtop the main stream channel into the flood plain mimicking the function of a natural channel condition. The modelled results show that flows as high as the 200-year event would easily be contained within the conceptual flood plain, and or within a combination of constructed channel and natural topography.

Table 2: Model output at identified flow conditions within the Seloam Brook Realignment preliminary design

Flow Condition (m3/s)	Estimated Model Discharge (m3/s)	Wetted Width (m)	Mean Water Velocity (m/s)	Mean Water Depth (m)	Maximum Water Depth (m)
1:20 Dry Annual (0.28)	0.28	2.16	0.47	0.28	0.33
MAF (0.82)	1.05	2.90	0.68	0.53	0.70
Q10 (11.1)	11.32	42.19	0.49	0.55	1.53
Q200 (22.2)	22.26	44.03	0.62	0.82	1.85

Summary

As shown by the model results for the preliminary channel design, an overall general flood plain width of 40-45m will easily contain the predicted 1:200 year flood event and that a main channel of 1.5m in bottom width and overall total wetted width of 3.0m would be capable of providing fish habitat similar to existing channel conditions. Greater detail regarding final channel design, 2-D extent of extreme flows, and possible use of existing topography to provide more natural flood conditions will be completed during the Fisheries Act authorization process.

Closure

The results of the modelling exercise are based on the general assumptions of the method and baseline conditions/information provided by others. The information has been generated to demonstrate that the preliminary Seloam Brook Realignment design can accommodate the design flows, and provide fish habitat and wetland/flood plain characteristics during low and high flow conditions.

Yours sincerely,

Wood Environment & Infrastructure Solutions,

a Division of Wood Canada Limited

Prepared by:

Matthew Gosse, BSc
Biologist

Reviewed by:

James McCarthy, MSc, CFP
Senior Associate Biologist, Ecosystem Insight Lead

References

Knight-Pieshold Consulting. 2020. Seloam Brook Diversion Channel Design Memo. April 14, 2020. Submitted to Atlantic Mining NS Corp, Nova Scotia. 17pp.

Newbury, R.W. and M.N. Gaboury. 1993. Stream Analysis and Fish Habitat Design; A Field Manual. Newbury Hydraulic Ltd. Gibsons, British Columbia. 186pp + Appendices.

Stalnaker C., Lamb B.L., Henriksen J., Bovee K. and J. Bartholow. 1994. The instream incremental methodology. A primer for IFIM. Biological Report, 29. Washington, DC, U.S. Department of the Interior, National Biological Service.

Appendix B

Golder Seloam Realignment Hydraulic Modelling Memorandum

Appendix B.9

Final – Seloam Brook Realignment Hydraulic Analysis, Downstream Environment Technical Memo, Golder Associates

GOLDER

TECHNICAL MEMORANDUM

DATE October 15, 2020 **Project No.** 1895674-Rev1

TO Jim Millard
Atlantic Mining NS Corp

CC Meghan Milloy, McCallum Environmental

FROM Shannon Percival; Steve Kaufman **EMAIL** Shannon_Percival@golder.com

SELOAM BROOK REALIGNMENT
HYDRAULIC ANALYSIS – DOWNSTREAM ENVIRONMENT
FIFTEEN MILE STREAM PROJECT

Introduction

Golder Associates Ltd. (Golder) was retained by Atlantic Mining NS Corp (AMNS), a wholly owned subsidiary of St. Barbara Ltd., to complete hydraulic modelling to support the on-going Environmental Impact Statement (EIS) for the Fifteen Mile Stream Gold Project (the Project). The Project is located 115 km east of Halifax, in Halifax county, in the province of Nova Scotia. The hydraulic modelling, as described herein, is specific to the planned Seloam Brook Realignment and the downstream receiving waterways that drain to Fifteen Mile Stream, and was completed in order to further investigate the conceptual placement of features downstream of the constructed channel that could reduce stream energy (velocity) and provide potential additional aquatic habitat.

Background

The Seloam Brook watershed consists of drainage from the following three main inflows:

- Seloam Brook from the outlet of Seloam Reservoir.
- Trafalgar Creek from the northern unregulated reaches of the watershed.
- An un-named waterway (termed WC-12 in accompanying EIS documentation) that drains the eastern reaches of the watershed.

These inflows discharge to a wetland complex that in turn drains west to Fifteen Mile Stream (Figure 1).

Project infrastructure will require the diversion of the main Seloam Brook tributary and the inflows from WC12 to the north of its existing path around the planned Open Pit (Figure 2). Therefore, a feasibility-level design of the Seloam Brook Realignment was completed by Knight Piésold (KP; 2020) and is referred to as "the Realignment" herein. Through further project development analysis and discussion, there was recognition that the Realignment as designed by KP had the potential to provide additional opportunity for habitat and fisheries offsetting. Wood Environment and Infrastructure Solutions, a Division of Wood Canada Limited (Wood; 2020), provided a revised and conceptual plan for the Realignment that incorporated these types of features and a more meandering low-flow stream alignment than the design proposed by KP (2020).

The net effect of the Realignment will be to route the main channel of Seloam Book and inflows from WC-12 to alternate receiving waterways within the Seloam Brook watershed. The purpose of the hydraulic modelling described in this memorandum is, therefore, to simulate the discharge pathways and water velocity for the receiving waterways downstream of the Realignment and to provide conceptual options for stream energy dissipation in the downstream environment.

Site Setting – Downstream Environment

At the outlet of the Realignment, flow diverges via a "North Channel" and a "South Channel". The North Channel flows west before its confluence with the main Seloam Brook reach, while the South Channel flows south to join with the main Seloam Brook reach (Figure 2).

Based on aerial imagery and field data provided by McCallum Environmental Limited (MEL), the North Channel is characterized as having a channel width ranging from 2.0 to 4.0 m, with floodplains dominated by grasses and alders. The South Channel is characterized as having a channel width ranging from approximately 2.0 m up to approximately 15.0 m with beaver activity noted within this area. Similar to the North Channel, the flood plains of the South Channel were noted to be dominated by grasses and alders. These characteristics indicate that the North Channel and South Channel are both low-gradient and low-energy components of the overall Seloam Brook watershed.

Methods and Model Inputs

A site-specific Hydraulic Engineering Centre River Analysis System (HEC-RAS) model was developed for the Realignment and downstream environment to the discharge of Seloam Brook to Fifteen Mile Stream. The model incorporated:

1) High-level design details from KP (2020), such as slope, dimensions, and outlet energy dissipation pad.

2) Estimated downstream (North Channel, South Channel, and Seloam Brook) stream and flood plain dimensions and stream bed roughness.

The Realignment design, as revised by Wood, was not modelled, rather, the range of stream velocity estimated through the revised design (Wood 2020) was compared from those modelled using the KP (2020) design for applicability to this downstream hydraulic assessment.

Modelling Conditions

In order to assess the North Channel and South Channel, the hydraulic model was simulated with the following conditions:

1) Baseline Conditions: An estimated existing discharge through the North Channel and South Channel.

1) Operations Conditions: An estimated future discharge through the North Channel and South Channel and downstream Seloam Brook, with the Realignment and several conceptual downstream energy dissipation features incorporated.

Seloam Brook Realignment Design

A feasibility-level design of the channel for the Realignment was completed by KP (2020). The dimensions of the channel, as proposed by KP (2020), were used in the model and are provided in Table 1.

Table 1: Seloam Brook Realignment Channel Key Dimensions

Location	Channel Slope (%)	Minimum Channel Depth (m)	Channel Base Width (m)	Channel Side Slope (H:V)
Seloam Brook Realignment	0.5	1.5	1.0	2:1

Natural Channels

Estimated stream gradient profiles for the North Channel and South Channel are summarized in Figure 3 and Figure 4. While stream and floodplain dimensions and grades were estimated based on the available topographic data and input from MEL, further characterization of these streams is ongoing in 2020 that can refine these estimates. The model input data used for the natural channels are summarized in Table 2.

Table 2: Natural Channel Parameters

Parameter	North Channel	South Channel
Channel Width Range	2.0 m to 4.0 m	2.0 m to 15.0 m
Maximum Channel Slope	2.6%	0.7%
Average Channel Slope	0.5%	0.3%

Stream Discharge

For consistency with EIS hydrology documentation, the hydraulic model was simulated for the average annual and the 95th percentile stream discharge conditions. Hydrological modelling completed for the EIS simulated flows at the outlet of Fifteen Mile Stream and, so, these flows were pro-rated by contributing upstream watershed size as inputs to the North Channel and South Channel from the Realignment. For the Operations Conditions scenario, the Realignment, and associated changes to watersheds as a result of infrastructure were accounted for.

Results

Stream Velocity

Baseline Conditions

While discharge provides an estimate of the total water moving through the system, it is the velocity of the water that drives the energy potential that leads to changes in stream morphology (sediment transport and deposition). Therefore, the focus of these results is on velocity in the receiving waterways.

Under mean discharge rates, simulated baseline water velocities through the North Channel ranged from 0.7 m/s to less than 0.1 m/s, with an average of approximately 0.2 m/s. Through the South Channel, simulated baseline stream velocity ranged from 0.6 m/s to less than 0.1 m/s, with an average of 0.2 m/s under mean discharge rates (Table 3).

For the 95th percentile discharge rate, simulated baseline stream velocity in the North Channel ranged from 0.8 m/s to less than 0.1 m/s, with an average of 0.3 m/s. For the South Channel simulated baseline stream velocity ranged from 0.7 m/s to less than 0.1 m/s, with an average of 0.3 m/s (Table 3).

Table 3: Baseline Conditions Stream Velocity

	Baseline Conditions					
	Mean Discharge			95th Percentile Discharge		
	Maximum – Velocity (m/s)	Average – Velocity (m/s)	Minimum – Velocity (m/s)	Maximum – Velocity (m/s)	Average – Velocity (m/s)	Minimum – Velocity (m/s)
North Channel	0.7	0.2	<0.1	0.8	0.3	<0.1
South Channel	0.6	0.2	<0.1	0.7	0.3	<0.1

Operations Conditions

Through an iterative process, energy dissipation features were added to the model domain that were intended to reduce stream velocity in the North Channel and South Channel. These features were conceptually considered to be check berms that would span the channel and floodplain. The optimization of the size, composition, and shape of these features will require additional study and collaboration with aquatic habitat disciplines. Conceptual placement of these structures is provided on Figure 5.

For the mean discharge scenario, simulated stream velocity through the North Channel ranged from 0.7 m/s to less than 0.1 m/s, with an average of approximately 0.2 m/s (Table 4). Through the South Channel, simulated stream velocity ranged from 0.3 m/s to less than 0.1 m/s, with an average of 0.1 m/s (Table 4).

For the 95th percentile discharge rate, simulated stream velocity in the North Channel ranged from 0.8 m/s to less than 1 m/s, with an average of 0.3 m/s (Table 4). In the South Channel, simulated stream velocity ranged from 0.5 m/s to less than 0.1 m/s, with an average of 0.2 m/s (Table 4).

Table 4: Operations Conditions Stream Velocity

	Operations Conditions					
	Mean Discharge			95th Percentile Discharge		
	Maximum – Velocity (m/s)	Average – Velocity (m/s)	Minimum – Velocity (m/s)	Maximum – Velocity (m/s)	Average – Velocity (m/s)	Minimum – Velocity (m/s)
North Channel	0.7	0.3	0.1	0.8	0.3	<0.1
South Channel	0.3	0.1	<0.1	0.5	0.2	<0.1

The range in simulated velocity along the channel lengths in Baseline Conditions and Operations Conditions are summarized in Figure 6 through Figure 9. Stream velocity simulated along the North Channel and South Channel in the Operation Conditions were similar to those simulated in the Baseline Conditions.

Stream velocity estimated for within the revised realignment plan (Wood 2020) are in the same order of magnitude of the analysis completed herein. These Wood (2020) estimates were for within the channel and not reflective of the plunge pool/dissipation basin incorporated in KP (2020). Therefore, it is likely that the conceptual placement and applicability of these downstream features remain consistent with this hydraulic modelling.

Flooding Extent

Under the Operation Conditions, the flood extent was also simulated with the addition of the structures. The resulting simulated flood extents for the mean average discharge rates and the 95th percentile of discharge rates are displayed on Figure 10 and Figure 11, respectively. In both scenarios, the flood extent was simulated with depths ranging from 1.8 m within the channel to a maximum depth of approximately 0.4 m in the floodplain.

Sediment Mobility

Simulated stream velocity was equal to or above 0.1 m/s for the North Channel and South Channel under Baseline and Operational Conditions. Typically, water velocity above 0.1 m/s have sufficient energy to mobilize finer particles such as silts and clays. With geomorphic analysis underway on these water features, additional detail will become available on the composition and potential mobility of sediments and the stability of the existing stream system. In turn, this work can inform the appropriate design of the Realignment and the downstream energy dissipation features.

Conclusions

The South Channel and North Channel of the Seloam Brook watershed were simulated within a hydraulic model. The model was simulated for under Baseline Conditions and Operations Conditions and for a mean discharge scenario, and a 95th percentile discharge scenario.

An increase in discharge (and stream velocity), as a result of the Realignment through tributaries of Seloam Brook, were simulated to be mitigated by the placement of energy dissipation features in the North Channel and South Channel. These conceptual features decrease overall simulated stream velocity (energy and sediment transport capability) to those simulated under Baseline Conditions. As a trade off, the flooded extent of the channels may occur. Therefore, additional studies will need to be completed that consider the optimization of the size, placement, and design of these features and associated additional potential aquatic habitat.

References

Knight Piésold Consulting (KP), 2020. Seloam Brook Diversion Channel Design. File No. VA101-00708/04-A.01.

Wood Environment and Infrastructure Solutions, a Division of Wood Canada Limited (Wood), 2020. Seloam Brook Realignment Section Model Results.

Closure

We trust that this memorandum meets your current requirements. Should you have questions regarding this memorandum please contact the undersigned.

Golder Associates Ltd.

Shannon Percival, B.Eng.,
EIT *Water Resource Specialist*

Steve Kaufman, M.Sc., EP
Associate, Hydrologist

SP/SK/sm

Attachments: Figures 1 to 11

https://golderassociates.sharepoint.com/sites/23819g/deliverables/1895674-xx realignment memo/rev 1 - october 2020/1895674-tm-rev1-atlantic gold hydraulic modelling 15oct_2020.docx

LEGEND

- Surface Water Flow Direction
- Watercourse
- Waterbody

0 400 800

1:20,000 METRES

NOTE(S)
1. ALL LOCATIONS ARE APPROXIMATE

REFERENCE(S)
1. MCCALLUM ENVIRONMENTAL LTD. EIS PROJECT AREA, (VER.190313, RECEIVED 2019-03-18).
2. MCCALLUM ENVIRONMENTAL LTD. PROPOSED INFRASTRUCTURE, (VER.190620, RECEIVED 2019-06-28).
PROJECTION: TRANSVERSE MERCATOR DATUM: NAD 83
COORDINATE SYSTEM: UTM ZONE 20 VERTICAL DATUM: CGVD28

CLIENT
ATLANTIC MINING NS CORP

Atlantic Gold

PROJECT
FIFTEEN MILE STREAM GOLD PROJECT

TITLE
EXISTING FLOW PATHS

CONSULTANT

GOLDER

YYYY-MM-DD	2020-10-15
DESIGNED	---
PREPARED	RRD
REVIEWED	SP
APPROVED	SK

PROJECT NO.	CONTROL	REV.	FIGURE
1895674	0032	1	1

LEGEND

- Surface Water Flow Direction
- Watercourse
- Waterbody
- Infrastructure

0 400 800
1:20,000 METRES

NOTE(S)
1. ALL LOCATIONS ARE APPROXIMATE

REFERENCE(S)
1. MCCALLUM ENVIRONMENTAL LTD. EIS PROJECT AREA, (VER.190313, RECEIVED 2019-03-18).
2. MCCALLUM ENVIRONMENTAL LTD. PROPOSED INFRASTRUCTURE, (VER.190620, RECEIVED 2019-06-28).
PROJECTION: TRANSVERSE MERCATOR DATUM: NAD 83
COORDINATE SYSTEM: UTM ZONE 20 VERTICAL DATUM: CGVD28

CLIENT
ATLANTIC MINING NS CORP
Atlantic Gold

PROJECT
FIFTEEN MILE STREAM GOLD PROJECT

TITLE
OPERATIONAL FLOW PATHS

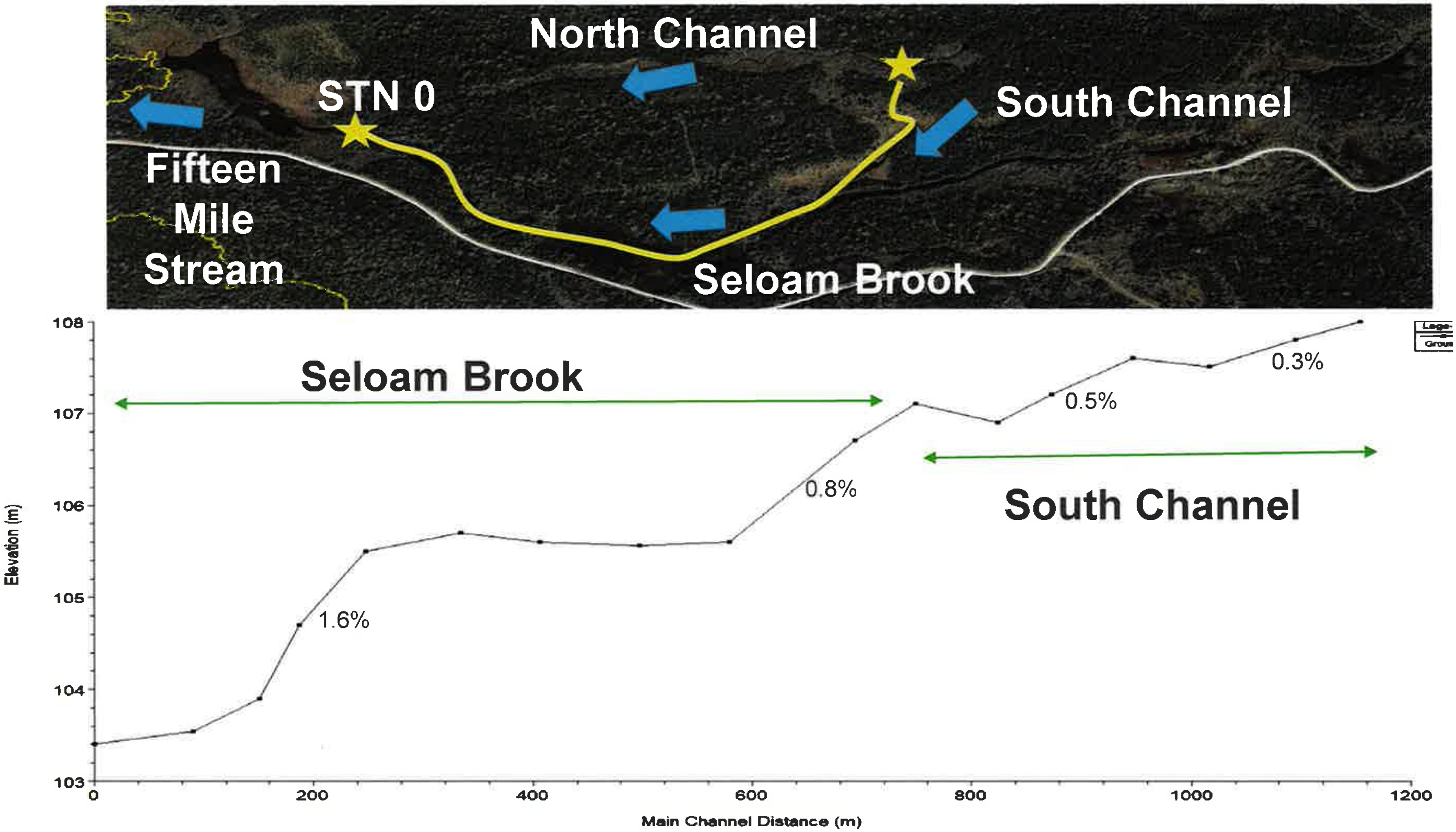
CONSULTANT
GOLDER

YYYY-MM-DD	2020-10-15
DESIGNED	---
PREPARED	RRD
REVIEWED	SP
APPROVED	SK

PROJECT NO.	CONTROL	0	FIGURE
1895674	0032	1	2

Atlantic Mining NS Corp
Seloam Brook Realignment – Hydraulic Analysis
South Channel and Seloam Brook Profile

FIGURE 3



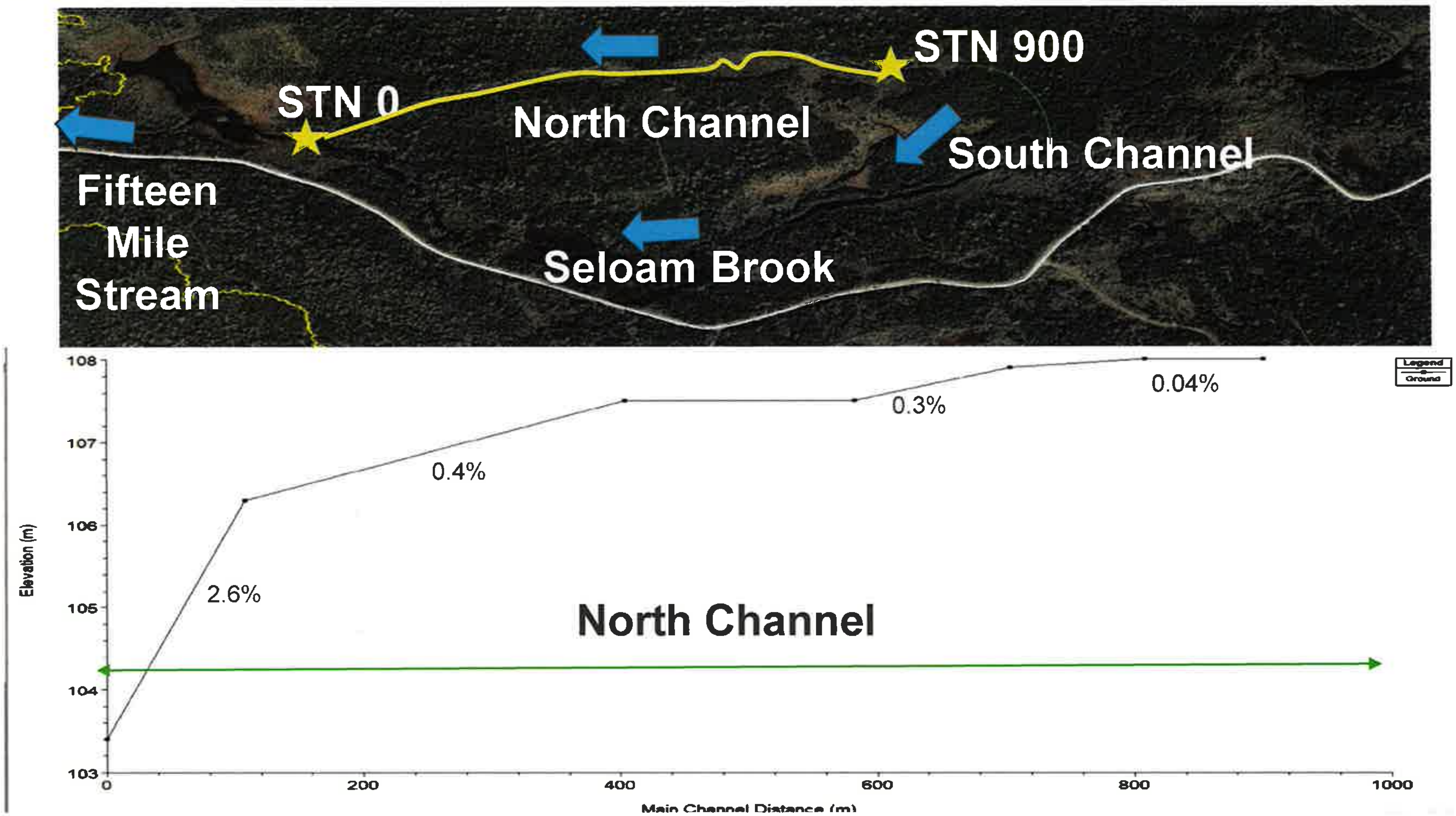
GOLDER

Date: October 2020
Project: 1895674

Drawn By: SF
Checked By: SK

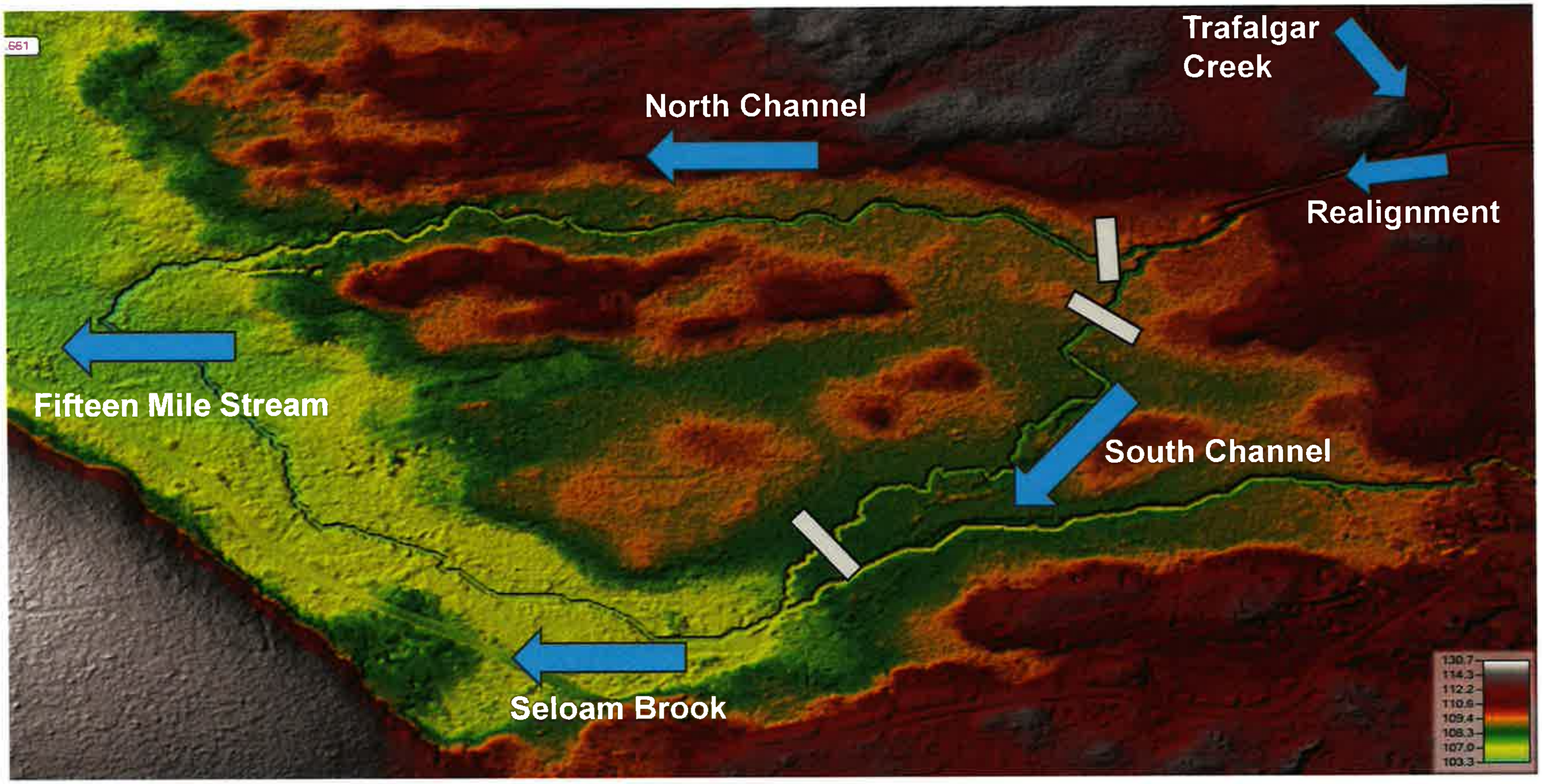
Atlantic Mining NS Corp
Seloam Brook Realignment – Hydraulic Analysis
North Channel Profile

FIGURE 4



Atlantic Mining NS Corp
Seloam Brook Realignment – Hydraulic Analysis
Operations Conditions – Conceptual Downstream Structure Placement

FIGURE 5



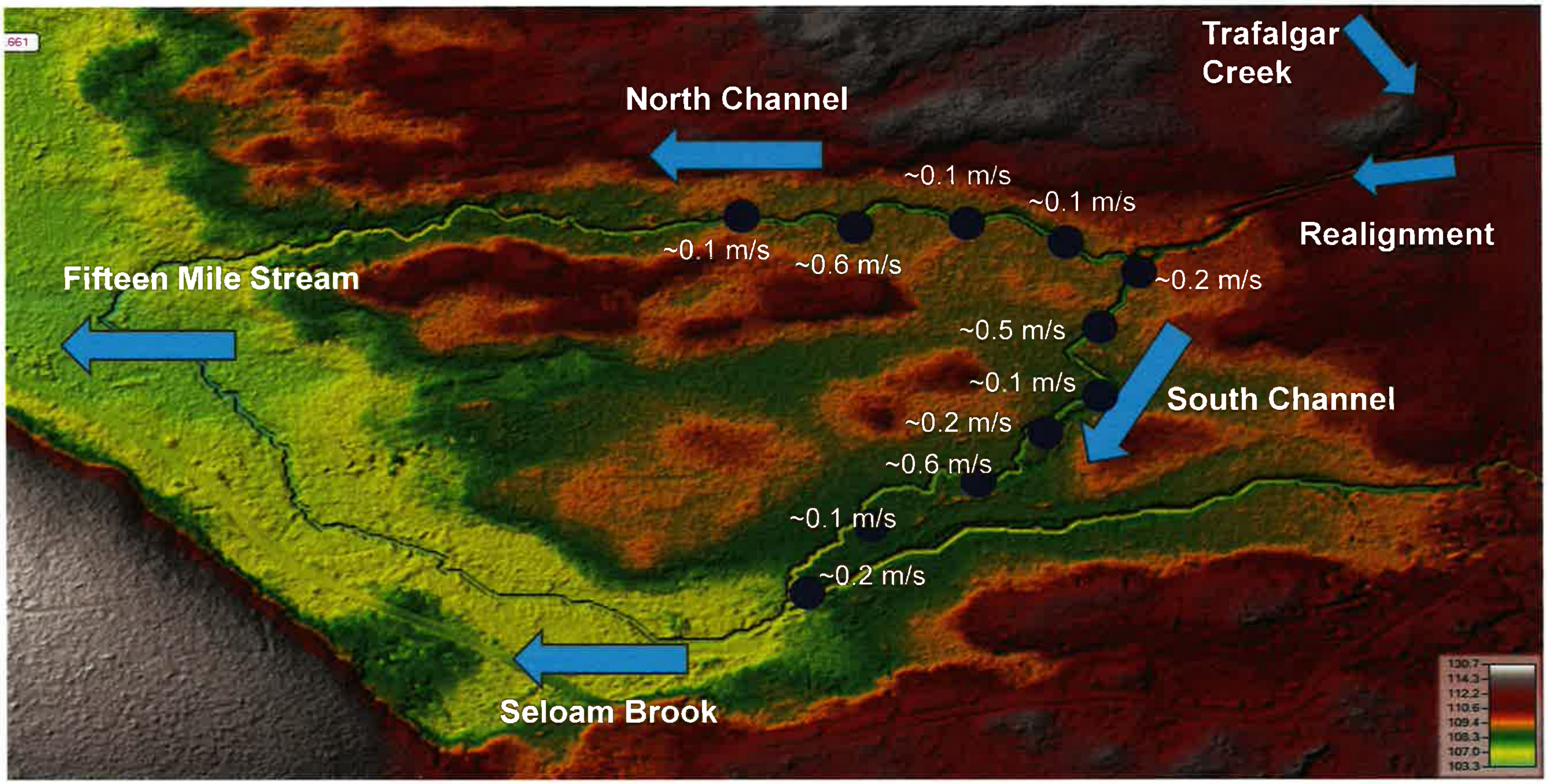
GOLDER

Date: October 2020
Project: 1895674

Drawn By: SF
Checked By: SK

Atlantic Mining NS Corp
Seloam Brook Realignment – Hydraulic Analysis
Baseline Conditions – Mean Discharge Rate
North Channel and South Channel Stream Velocity

FIGURE 6



Velocity simulation location

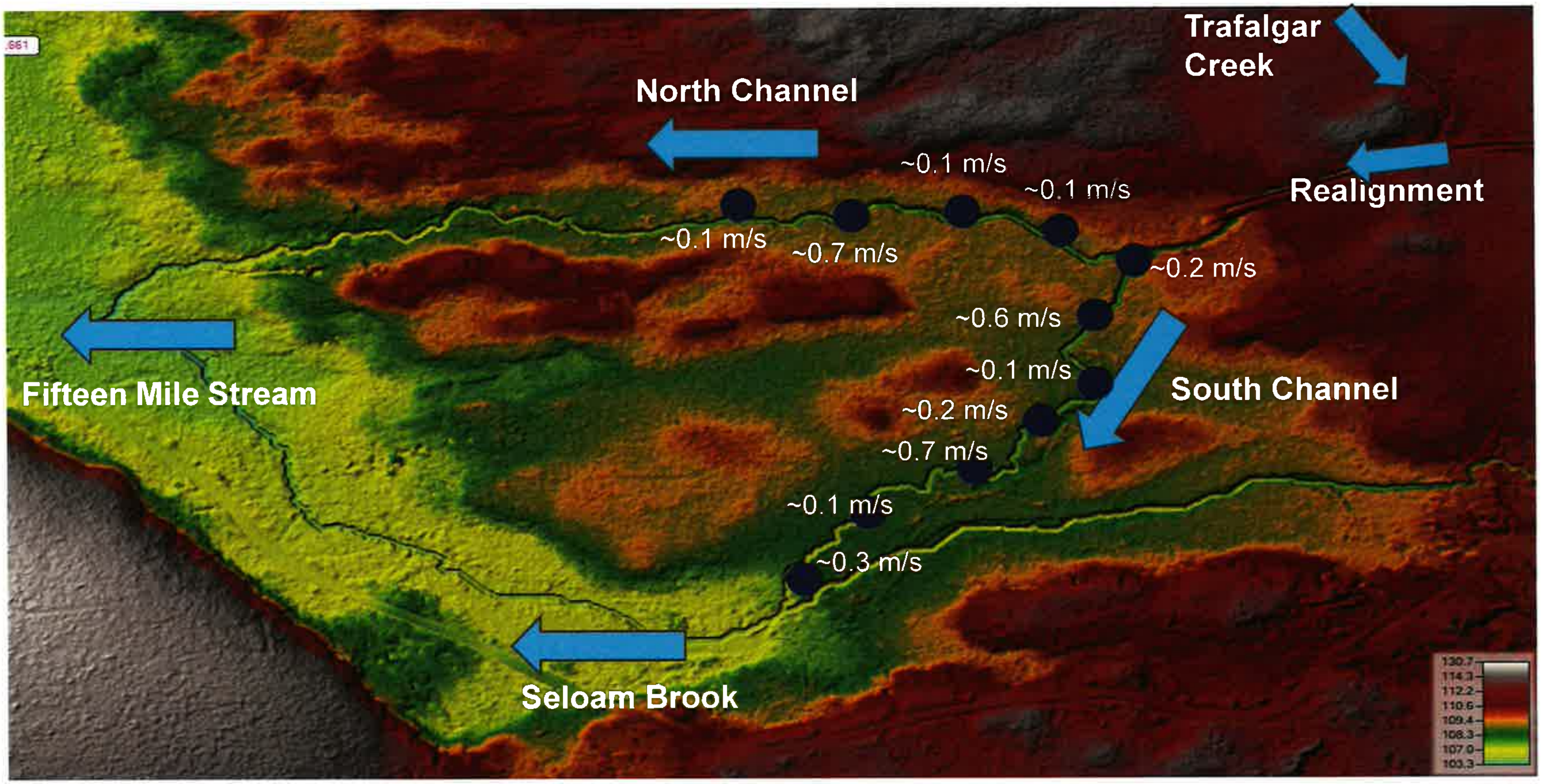
GOLDER

Date: October 2020
Project: 1895674

Drawn By: SF
Checked By: SK

Atlantic Mining NS Corp
Seloam Brook Realignment – Hydraulic Analysis
Baseline Conditions – 95th Percentile Discharge Rate
North Channel and South Channel Stream Velocity

FIGURE 7



● Velocity simulation location

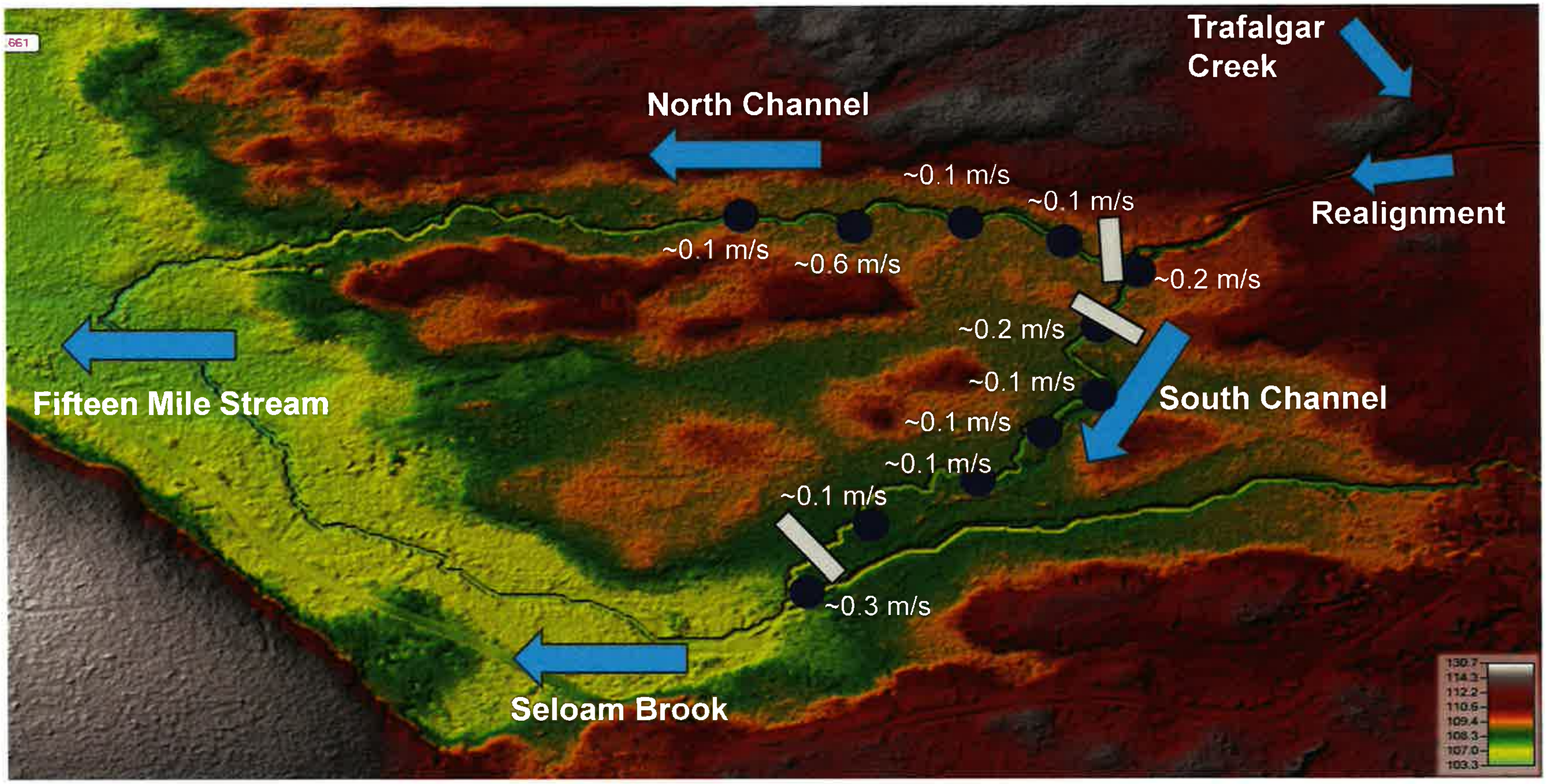
GOLDER

Date: October 2020
Project: 1895674

Drawn By: SF
Checked By: SK

Atlantic Mining NS Corp
Seloam Brook Realignment – Hydraulic Analysis
Operations Conditions – Mean Discharge Rate
North Channel and South Channel Stream Velocity

FIGURE 8



● Velocity simulation location

▭ Energy Dissipation Feature

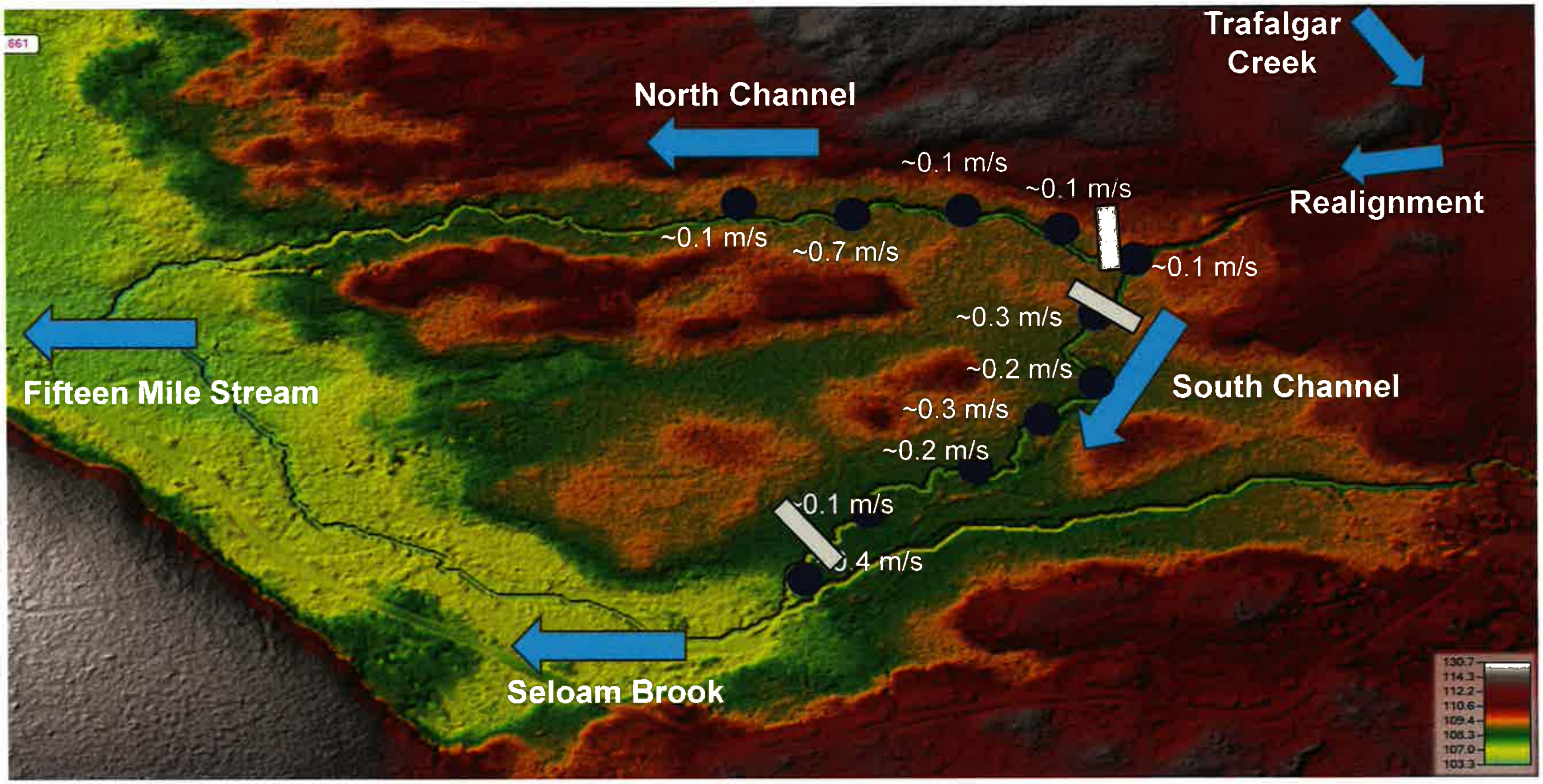
GOLDER

Date: October 2020
Project: 1895674

Drawn By: SF
Checked By: SK

Atlantic Mining NS Corp
Seloam Brook Realignment – Hydraulic Analysis
Operations Conditions – 95th Percentile Discharge Rate
North Channel and South Channel Stream Velocity

FIGURE 9



Velocity simulation location

Energy Dissipation Feature

LEGEND

simulated Flooded Extent

0 80 160

1:4,000 METRES

NOTE(S)

1. ALL LOCATIONS ARE APPROXIMATE

REFERENCE(S)

1. MCCALLUM ENVIRONMENTAL LTD. EIS PROJECT AREA, (VER.190313, RECEIVED 2019-03-18).
2. MCCALLUM ENVIRONMENTAL LTD. PROPOSED INFRASTRUCTURE, (VER.190620, RECEIVED 2019-06-28).

PROJECTION: TRANSVERSE MERCATOR DATUM: NAD 83
COORDINATE SYSTEM: UTM ZONE 20 VERTICAL DATUM: CGVD28

CLIENT
ATLANTIC MINING NS CORP

Atlantic Gold

PROJECT
FIFTEEN MILE STREAM GOLD PROJECT

TITLE
FLOODED EXTENT - AVERAGE ANNUAL DISCHARGE

CONSULTANT

GOLDER

YYYY-MM-DD	2020-10-15
DESIGNED	---
PREPARED	RRD
REVIEWED	SP
APPROVED	SK

PROJECT NO.	CONTROL	REV.	FIGURE
1895674	0032	1	10

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM ANSI B

25mm

LEGEND

Simulated Flooded Extent

0 80 160

1:4,000 METRES

NOTE(S)

1. ALL LOCATIONS ARE APPROXIMATE

REFERENCE(S)

1. MCCALLUM ENVIRONMENTAL LTD. EIS PROJECT AREA, (VER.190313, RECEIVED 2019-03-18).
2. MCCALLUM ENVIRONMENTAL LTD. PROPOSED INFRASTRUCTURE, (VER.190620, RECEIVED 2019-06-28).

PROJECTION: TRANSVERSE MERCATOR DATUM: NAD 83
COORDINATE SYSTEM: UTM ZONE 20 VERTICAL DATUM: CGVD28

CLIENT
ATLANTIC MINING NS CORP

Atlantic Gold

PROJECT
FIFTEEN MILE STREAM GOLD PROJECT

TITLE
FLOODED EXTENT -95TH PERCENTILE DISCHARGE

CONSULTANT

GOLDER

YYYY-MM-DD	2020-10-15
DESIGNED	—
PREPARED	RRD
REVIEWED	SP
APPROVED	SK

PROJECT NO.	CONTROL	REV.	FIGURE
1895674	0032	1	11